3. East Tennessee Technology Park

ETTP was originally built during World War II as part of the Manhattan Project. Known as the K-25 Site, its primary mission was to enrich uranium for use in atomic weapons. After the war, the mission was changed to include the enrichment of uranium for nuclear reactor fuel elements and recycling of uranium recovered from spent fuel, and the name was changed to the Oak Ridge Gaseous Diffusion Plant. In the 1980s, a reduction in the demand for nuclear fuel resulted in the shutdown of the enrichment process, and production ceased. The emphasis of the mission then changed to environmental management and restoration operations, and the name was changed to the East Tennessee Technology Park. Environmental management and remediation operations consist of operations such as waste management, the cleanup of outdoor storage and disposal areas, the demolition and/or cleaning up of the facilities, land restoration, and environmental monitoring. Proper disposal of the huge quantities of waste that were generated over the course of production operations is also a major task. Beginning in the 1990s, reindustrialization (the conversion of underused government facilities for use by the private sector) also became a major mission at ETTP. Reindustrialization allows private industry to lease underused facilities, thus providing both jobs and a new use for facilities that otherwise would have to be demolished. In 2011, UCOR replaced BJC as the prime environmental contractor for ETTP. State and federally mandated effluent monitoring and environmental surveillance at ETTP involve the collection and analysis of samples of air, water, soil, sediment, and vegetation from ETTP and the surrounding area. Data from the monitoring are used to assess exposures of members of the public and the environment, to assess the performance of treatment systems, to help identify areas of concern and plan remediation efforts, and to evaluate the efficacy of these remediation efforts. In 2011, there was better than 99% compliance with permit standards for emissions from ETTP operations.

3.1 Description of Site and Operations

Construction of ETTP (Fig. 3.1), originally known as the K-25 Site, began in 1943 as part of the World War II Manhattan Project. The plant's original mission was the production of enriched uranium for nuclear weapons. Enrichment was initially carried out in the S-50 thermal diffusion process facility, which operated for 1 year, and the K-25 and K-27 gaseous diffusion process buildings. Later, the K-29, K-31, and K-33 buildings were built to increase the production capacity of the original facilities by raising the assay of the feed material entering K-27. Following the war years, the site became officially known as the Oak Ridge Gaseous Diffusion Plant (ORGDP).

After military production of highly enriched uranium ceased in 1964, the two original process buildings were shut down. For the next 20 years, the plant's primary mission was the production of only low-enriched uranium to be fabricated into fuel elements for nuclear reactors. Other missions during the latter part of this 20-year period included development and testing of the gas centrifuge method of uranium enrichment and laser isotope separation research and development (R&D).

By 1985, the demand for enriched uranium had declined, and the gaseous diffusion cascades at ORGDP were placed in standby mode. That same year, the gas centrifuge program was canceled. The decision to permanently shut down the diffusion cascades was announced in late 1987, and actions necessary to implement that decision were initiated soon thereafter. Because of the termination of the original and primary missions, ORGDP was renamed the "Oak Ridge K-25 Site" in 1990. Figure 3.2 shows the K-25 Site areas before the start of decontamination and decommissioning (D&D) activities. In 1997, the K-25 Site was renamed the "East Tennessee Technology Park" to reflect its new mission.

ORNL 2010-G00441/chj

Fig. 3.1. East Tennessee Technology Park.

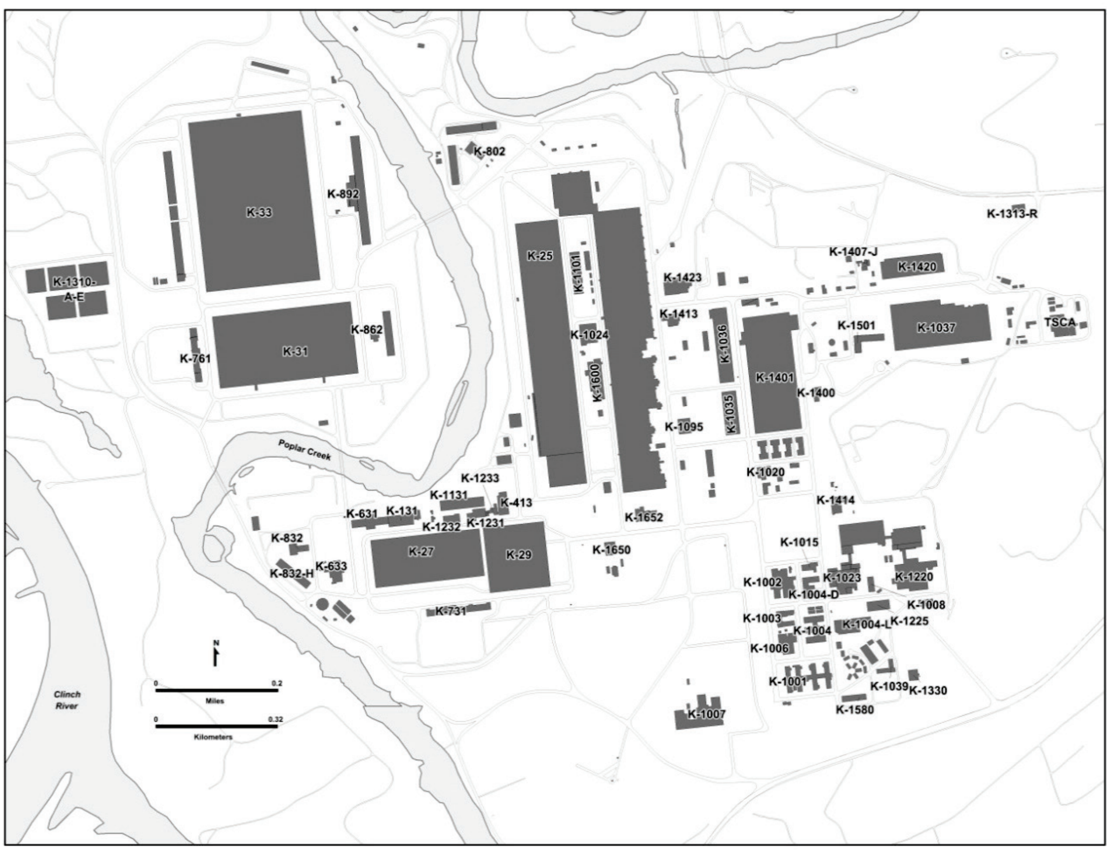

Fig. 3.2. East Tennessee Technology Park before the start of decontamination and decommissioning activities in 1991.

Figure 3.3 shows the major facilities at ETTP, including those where D&D activities have been completed as of 2011. The ETTP mission is to reindustrialize and reuse site assets through leasing excess or underused land and facilities and through incorporating commercial industrial organizations as partners in the ongoing environmental restoration, D&D, and waste treatment and disposal.

DOE's long-term goal for ETTP is to convert as much as possible of the site into a private mixed-use business and industrial park. The site is undergoing environmental cleanup of its land as well as D&D of most of its buildings. The reuse of key facilities through title transfer is part of the site's closure plan. The cleanup approach makes land and various types of buildings (e.g., office, manufacturing) suitable for private industrial use and for title transfer to CROET or other entities such as the city of Oak Ridge. The facilities may then be subleased or sold, with the goal of stimulating private industry and recruiting business to the area.

UCOR, the environmental management contractor for ETTP, supports DOE in the reindustrialization program that transferred three building and two land parcels to CROET as DOE continued its effort to transform ETTP into a private-sector industrial park. In 2011, two land parcels at ETTP were transferred to private companies. Construction was also completed on speculative buildings on two of the parcels that had been transferred to CROET, and one of these buildings was sold to a private corporation. Unless otherwise noted, information on non-DOE entities located on the ETTP site is not provided in this document.

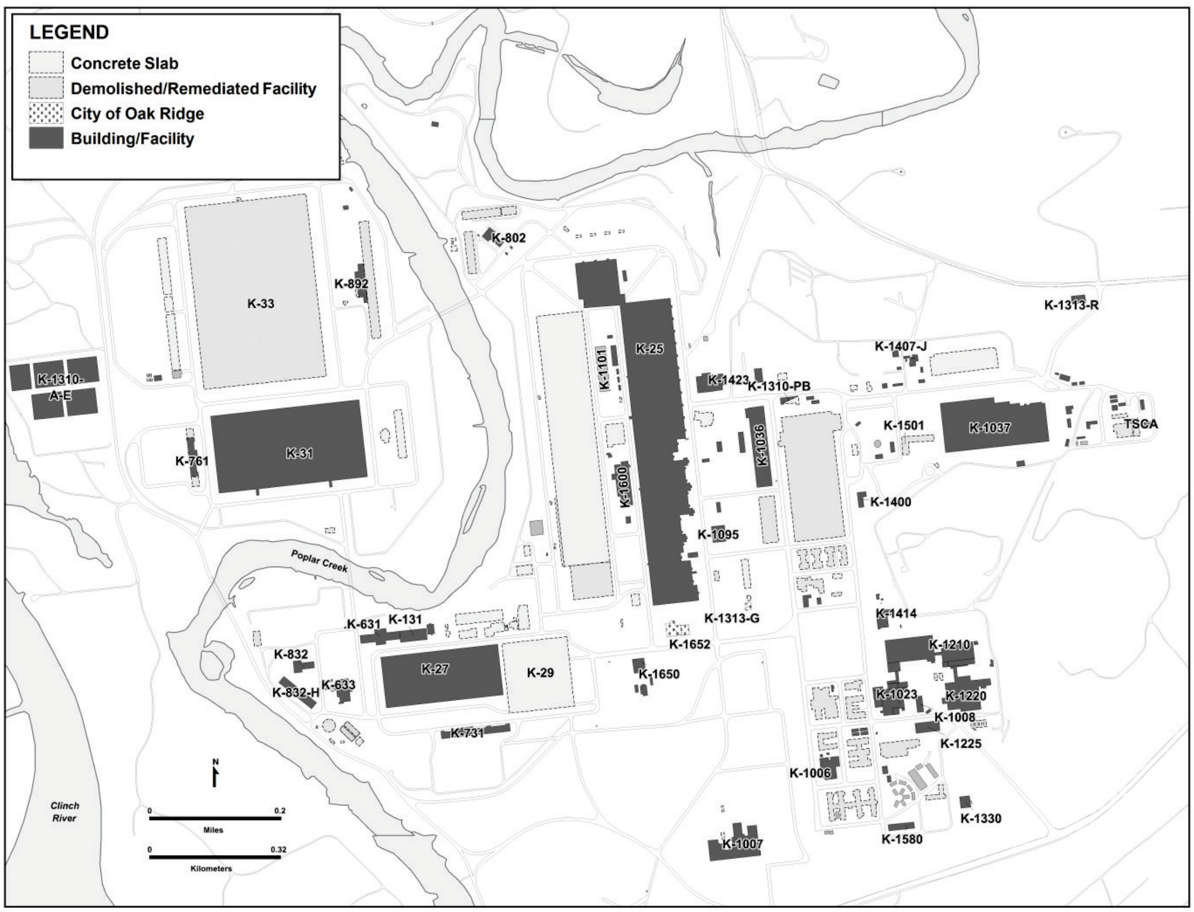

Fig. 3.3. East Tennessee Technology Park in 2011.

3.2 Environmental Management System

The UCOR Environmental Management System (EMS) is integrated with the UCOR Integrated Safety Management System (ISMS). UCOR's EMS is based on a graded approach for a closure and remediation contract and reflects the elements and framework contained in International Organization for Standardization standard 14001:2004 (ISO 14001:2004). UCOR is committed to incorporating sound environmental management, protection, and sustainability practices in all work processes and activities that are part of the DOE EM program in Oak Ridge, Tennessee. UCOR's environmental policy states, "our commitment to protect and sustain human, natural, and cultural resources is inherent in our mission to complete environmental cleanup safely with reduced risks to the public, workers, and the environment." To achieve this, UCOR's environmental policy adheres to the following principles.

- **Management Commitment**—Integrate responsible environmental practices into project operations.
- **Environmental Compliance and Protection**—Comply with all environmental regulations and standards.
- **Sustainable Environmental Stewardship**—Minimize the effects of our operations on the environment through a combination of source reduction, recycling, and reuse; sound waste management practices; and pollution prevention.
- **Partnership/Stakeholder Involvement**—Maintain partnerships through effective two-way communications with our customer and other stakeholders.

3.2.1 Environmental Stewardship Scorecard

The Environmental Stewardship Scorecard is used to track and measure site-level EMS performance. During 2011, UCOR received "green scores" for EMS performance. As an example, Figure 3.4 presents information on UCOR's pollution prevention recycling activities for 2011.

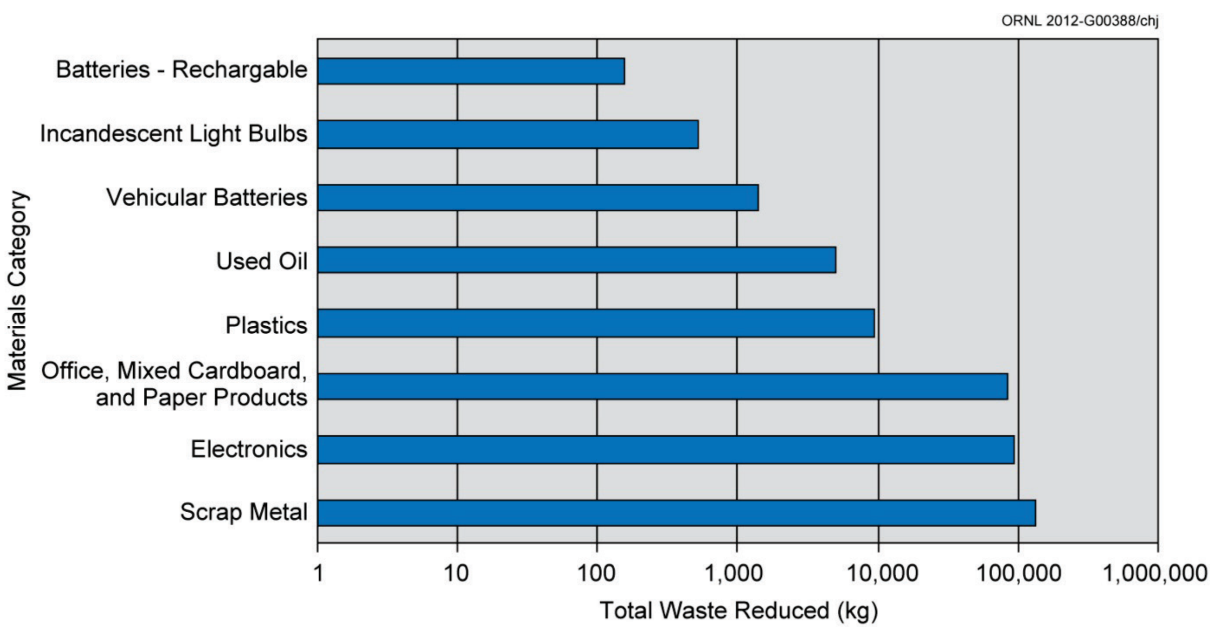

Fig. 3.4. Pollution prevention recycling activities related to solid waste reduction at East Tennessee Technology Park in 2011.

3.2.2 Environmental Compliance

UCOR maintains various layers of oversight to ensure compliance with legal and other requirements. The methods of evaluation include independent assessments by outside parties, management assessments conducted by functional or project organizations, and routine field walkdowns conducted by a variety of functional and project personnel. Management and independent assessments are performed in accordance with *Management Assessment*, PROC-PQ-1420, and *Independent Assessment*, PROC-PQ-1401. Assessments are scheduled on the UCOR Assessments SharePoint Site in accordance with PROC-PQ-1420. Records are maintained for all formal assessments and audits. Issues identified in assessments are handled as required by ISO 14001, Section 4.5.3, "Nonconformity, Corrective Action, and Preventive Action" (ISO 2004).

In addition, external assessments and regulatory inspections are performed by DOE and regulatory agencies such as TDEC and EPA.

As required by DOE O 436.1, an independent assessment of UCOR's EMS in accordance with PROC-PQ-1401 is conducted every 3 years. In addition, during years when an independent assessment is not conducted, a management assessment of the EMS program is performed in accordance with PROC-PQ-1420. Also, routine functional environmental compliance management assessments evaluate the various elements described in ISO 14001. Independent and management assessments are scheduled in advance, and the schedule is maintained on UCOR's Quality Assurance (QA) System located on the intranet.

Results of all assessments are provided to management, and corrective actions are tracked in the UCOR Issues and Corrective Action Tracking System (I/CATS) in accordance with PROC-PQ-1210, *Issues Management Program*, as required by ISO 14001, Section 4.5.3, "Nonconformity, Corrective Action, and Preventive Action" (ISO 2004).

Initial validation of UCOR's current EMS program occurred in December 2005. At that time, the applicable DOE order governing the EMS program was DOE O 450.1A, *Environmental Protection Program.* An internal independent assessment was performed in September 2007 under BJC management, and an evaluation by an outside party, as required by DOE O 450.1A (since replaced by DOE O 436.1), was conducted in March 2009. BJC formally declared conformance with EMS requirements contained in DOE O 450.1A on May 6, 2009. A DOE-led verification assessment of BJC's EMS was conducted in June 2009 and concurred with BJC's declaration, stating that "Bechtel Jacobs Company LLC (BJC) has implemented an Environmental Management System (EMS) that is consistent with the requirements of DOE O 450.1A, *Environmental Protection Program*."

3.2.3 Environmental Aspects/Impacts

Using a graded approach appropriate for EMS includes an environmental policy that provides a unified strategy for the management, conservation, and protection of natural resources; the control and attenuation of risks; and the establishment and attainment of all environment, safety, and health (ES&H) goals. UCOR works continuously to improve EMS to reduce impacts from activities and associated effects on the environment (i.e., environmental aspects) and to communicate and reinforce this policy to its internal and external stakeholders.

At the program/company level, environmental aspects are documented and are reviewed at least annually and updated as necessary. Significant environmental aspects are identified using a systematic process that considers various risk factors (e.g., regulatory risk, environmental risk, mission impact, and probability) in determining significance. This process is described in *Evaluation of URS | CH2M Oak Ridge LLC Activities and Ranking of Environmental Aspects/Impacts* (UCOR 2012a). UCOR work activities, services, and products were initially reviewed to determine the associated environmental aspects and impacts and are reevaluated on an ongoing basis as new work activities are initiated.

Continuous improvement opportunities are identified in a number of ways including, but not limited to, ongoing independent and management assessments, external DOE assessments, regulatory inspections, worker feedback, and senior management reviews of UCOR's EMS components. Figure 3.5 provides a model that illustrates the components and key steps of UCOR's EMS.

The UCOR corporate policy emphasizes the company's core values by promoting commitment to ISMS. The objective of ISMS is to systematically integrate ES&H, pollution prevention, waste minimization, and QA into management and work practices at all levels so that workers, the public, and the environment are protected while missions are accomplished and feedback for continuous improvement is obtained.

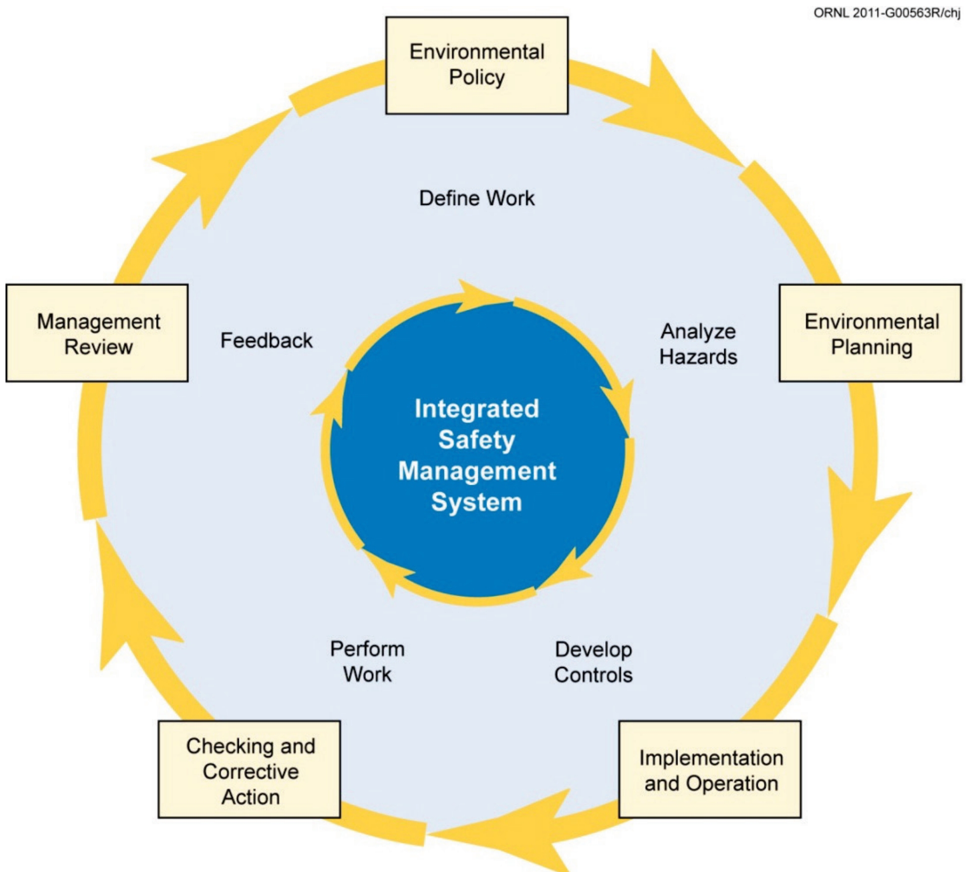

Fig. 3.5. UCOR Environmental Management System key elements.

The Environmental Compliance and Protection (EC&P) oversight program is an integral part of the UCOR EMS mandated by presidential EO 13423, *Strengthening Federal, Environmental, Energy, and Transportation Management*, and reinforced in presidential EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*. DOE O 436.1 requires each DOE operation to implement an EMS as part of the existing ISMS that was established pursuant to DOE P 450.4A, *Integrated Safety Management Policy*. UCOR uses its ISMS to implement the EMS, including EC&P considerations, into the line oversight program at DOE sites managed by UCOR. DOE O 436.1 also requires implementation and development of pollution prevention and sustainable environmental stewardship goals.

3.2.4 Environmental Performance Objectives and Targets

UCOR conserves and protects environmental resources by incorporating environmental protection and the elements of an enabling EMS into the daily conduct of business; fostering a spirit of cooperation with federal, state, and local regulatory agencies; and using appropriate waste management, treatment, storage, and disposal methods. The environmental performance objectives are to achieve zero unpermitted discharges to the environment; comply with all conditions of environmental permits, laws, regulations, and DOE orders; integrate EMS and environmental considerations as part of ISMS; and, to the extent practicable, reduce waste generation, prevent pollution, maximize recycle and reuse potential, and encourage environmentally preferable procurement of materials with recycled and bio-based content.

UCOR has established a set of core EMS objectives that remain relatively unchanged from year to year. These objectives are generally applicable to all operations and activities throughout UCOR’s work scope. The core environmental objectives are based on complying with applicable legal requirements and sustainable environmental practices contained in DOE O 436.1 and include the following:

- comply with all environmental regulations, permits, and regulatory agreements;
- encourage reducing or eliminating the generation and/or toxicity of waste and other pollutants at the source through pollution prevention;
- encourage reducing or eliminating acquisition, use, and release of toxic, hazardous, and radioactive materials and greenhouse gases (GHGs) by acquiring environmentally preferable products and conduct of operations;
- reduce degradation and depletion of environmental resources through postconsumer material recycling; energy, fuel, and water conservation efforts; and use or promotion of renewable energy;
- reduce or eliminate the environmental impact of electronics assets; and
- reduce the environmental impact of UCOR operations on surface water and groundwater resources.

In addition to the core objectives listed above, UCOR establishes company-level ad hoc objectives and targets each year that are based on changing priorities, changing legal requirements, and other areas of emphasis. Each year the complete list of core and ad hoc environmental objectives and targets is distributed by the UCOR president for the upcoming calendar year. The list also includes designations of responsibility and time frames by which actions are to be taken to facilitate achievement of the objectives and targets. The statuses of objectives and targets are periodically reviewed throughout the year at EC&P leader meetings and management reviews.

Project-specific EMS objectives and targets are developed annually near the beginning of each calendar year and are based on company-level objectives and targets, taking into consideration significant environmental aspects and legal requirements of project operations. The EC&P lead reviews the statuses of the project-level environmental objectives and targets with project management periodically and with the EC&P program manager during EC&P leader meetings.

EMS is part of ISMS in that it relies on the existing ISMS five core functions, seven guiding principles, and worker participation to fully integrate EC&P considerations into all work processes. As previously stated, UCOR's EMS is based on the elements and framework contained in ISO 14001. Each element is addressed in *URS | CH2M Oak Ridge LLC Environmental Management System Implementation Description* (UCOR 2012b). For each element, this document provides the related implementing documents, implementation description, and roles and responsibilities. Depending on the scope of work involved, there are EMS attributes or actions related to the environment that an individual could apply at each of the five core functions. Such actions are specifically relevant to environmental compliance, protection of natural resources, prevention of pollution, and minimization of waste. When EMS attributes or actions are applied through the ISMS process, the elements of the EMS Program become an integral part of a continuing cycle of planning, implementing, evaluating, and improving processes and actions. EMS is supported at each of the five core functions of ISMS, and ISMS provides the framework for implementing EMS policies, processes, and tools in all phases of work. The UCOR definition of "safety" embodies protection of workers, the public, and the environment.

3.2.5 Implementation and Operations

UCOR protects the safety and health of workers and the public by identifying, analyzing, and mitigating aspects, hazards, and impacts from ETTP operations and by implementing sound work practices. All UCOR employees and subcontractors are held responsible for complying with all ES&H requirements during all work activities and are expected to correct noncompliant conditions immediately. UCOR internal management assessments also provide a measure of how well EMS attributes are integrated into work activities through ISMS. UCOR has embodied its program for EC&P of natural resources in a companywide environmental management and protection policy. The policy is UCOR's fundamental commitment to incorporating sound environmental management practices into all work processes and activities.

3.2.6 Pollution Prevention/Waste Minimization

UCOR's work control process requires that all waste-generating activities be evaluated for source reduction and product substitution be used to produce a less toxic waste when possible. The reuse or recycling of building debris or other wastes generated is evaluated in all cases.

UCOR recycles office and mixed paper, cardboard, phone books, newspapers, magazines, aluminum cans, antifreeze, engine oils, batteries (lead acid, universal waste, and alkaline), universal waste bulbs, plastic bottles, all types of #1 and #2 plastics, and surplus electronic assets such as computers (CPUs and laptops) and monitors (CRT and LCD). Other recycling opportunities include unique structural steel, stainless steel structural members, transformers, and electrical breakers. Figure 3.4 shows pollution prevention recycling activities at ETTP related to solid waste reduction.

UCOR's electronic stewardship program is award winning. For 2011, the ETTP site was recognized by DOE with an EStar (Environmental Sustainability) Award for Sustainability in Onsite Shipping. The award was given for the Radio Frequency Identification Transportation System (RFITS), an electronic manifesting and waste tracking system that uses radio frequency identification (RFID) and other technologies to ship hazardous materials while maintaining compliance. This enhanced transportation logistics management system tracks and monitors complex-wide on-site waste shipments to EMWMF. An integrated portal monitoring station that is part of RFITS is shown in Fig. 3.6. The RFITS program has eliminated errors associated with manual data entry, improved cycle times by 25 minutes per truck shipment (i.e., saving large quantities of fuel and paper that significantly reduces GHG emissions), improved performance of vehicle searches at truck stations at controlled area exits, and centralized logistics for all shipments to EMWMF. The overall project cost savings of $11.28 million from using RFITS is shown in Table 3.1. Additionally, EPA awarded ETTP the 2011 Federal Electronics Challenge Award (Gold) at the White House Conference Center in Washington, DC, (Fig. 3.7) for its electronics assets management achievements, including the RFITS program. In 2011 information on RFITS was shared with federal agencies such as DOE, the Department of Defense, and the Department of Transportation. The ETTP UCOR team has also engaged in congressional mentoring to raise awareness of electronic shipping in commerce in support of the Hazardous Waste Electronics Manifest Establishment Act, whose purpose is to direct the administrator of EPA to establish a hazardous waste electronic manifesting system to track the cradle-to-grave management of hazardous waste under RCRA.

ORNL 2011-G00565/chj

Fig. 3.6. A waste shipment passing an electronic tracking station as it prepares to enter the haul road from East Tennessee Technology Park en route to EMWMF.

Table 3.1. Radio Frequency Identification Transportation System sustainable results

Sustainable Factor	Results
Diesel fuel use avoidance	77,519 L
NO_X and CO_2 emissions avoidance	3,596 and 205,383 kg
Paper and trees saved	2.38 MT and 57 trees
Electricity saved	35.107 MJ
Water use avoided	63,023 L
Total project cost savings	**$11.28 million**

ORNL 2012-G00362/chj

Fig. 3.7. Members of the East Tennessee Technology Park Information Technology department being presented with the US Environmental Protection Agency 2011 Federal Electronics Challenge Gold Award.

Other noteworthy activities include UCOR internal recognition of five projects for their pollution prevention/waste minimization accomplishments during the year, continued expansion of the RFITS program beyond UCOR through mentoring other sites, continued use of "green products" whenever possible and evaluation of large quantity purchases for less toxic alternatives, and continued maintenance of UCOR's extensive recycling program that benefits the local community through donations to local charities of proceeds from aluminum beverage can recycling efforts.

3.2.7 Competence, Training, and Awareness

The UCOR training and qualification process ensures that needed skills for the workforce are identified and developed. The process also documents knowledge, experience, abilities, and competencies of the workforce for key positions requiring qualification. This process is described in PROC-TC-0702, *Training Program*. Completion and documentation of training, including required reading, are managed by the Local Education Administration Requirements Network.

A number of training modules and awareness tools have been developed and used to increase general knowledge and awareness of UCOR's environmental policy and to communicate roles and responsibilities for all employees. Additionally, employees and subcontractors involved in a work activity that may have a significant impact on the environment are provided additional information through review of work packages; procedures; pre-job briefings; and Safety Task Analysis Risk Reduction Talk cards, which address potential environmental issues and concerns.

In addition to the formal training modules and project-specific work briefings, UCOR uses a number of tools and mechanisms to constantly reinforce awareness and knowledge of UCOR's EMS.

3.2.8 Communication

UCOR has decided to communicate externally regarding environmental aspects through the UCOR public website, which includes a link to its environmental policy statement, POL-UCOR-007; a list of environmental aspects; and a link to the ISMS Description (BJC 2010). A number of other documents and reports that address environmental aspects and cleanup progress are also published and made available to the public (e.g., the Annual Site Environmental Report, Annual Cleanup Progress Report). UCOR participates in a number of public meetings related to environmental activities at the site (e.g., Site Specific Advisory Board meetings, permit review public meetings, and CERCLA decision document public meetings). Written communications from external parties are tracked using the weekly Open Action Report.

3.2.9 Benefits and Successes of Environmental Management System Implementation

UCOR uses EMS objectives and targets, an internal pollution prevention recognition program, environmentally preferable purchasing, work control processes, and a recycle program to meet sustainability and stewardship goals and requirements. The approach is outlined in UCOR's *Pollution Prevention and Waste Minimization Program Plan for the East Tennessee Technology Park, Oak Ridge, Tennessee* (UCOR 2012e).

UCOR has initiated the following energy conservation measures that saved money, energy, and, subsequently, pollution from power generation or vehicle emissions.

- Energy Star appliances are purchased whenever possible. These appliances meet strict energy-efficient guidelines set by EPA and DOE. Energy Star is an international standard for energy-efficient consumer products.
- The information technology (IT) department purchases only Electronic Product Environmental Assessment Tool (EPEAT) silver- or gold-certified computers and monitors. EPEAT is an easy-to-use online tool that helps institutional purchasers evaluate, compare, and select electronic products based on their environmental attributes. Additionally, the IT department is creating awareness and is implementing desktop energy-saving measures for computers, monitors, printers, and copiers.
- The Space Consolidation/Utilization Project eliminated facility/trailer types resulting in an energy use avoidance.
- The RFITS Shipping Project implemented as of the end of CY 2011 resulted in a 77,519 L reduction in the use of diesel fuel, electricity savings of 35,107 MJ, paper and tree savings of 2.38 MT and 57 trees, water use avoidance of 63,023 L, and air pollution avoidance of 64.9 kg.
- General maintenance purchases WaterSense replacement parts when performing repairs. WaterSense is an EPA program designed to encourage water efficiency through the use of a special label on consumer products such as toilets, flushing urinals, bathroom sink faucets, and accessories.
- Garage personnel use recycled content coolant (ethylene glycol) that is a 50-50 blend of recycled-new coolant and several bio-based products including oils and cleaners, which result in less toxic or nontoxic waste generation.

3.2.10 Management Review

Senior management review of EMS is performed at several layers and frequencies. A formal review/presentation with UCOR senior management that addresses the requirement elements contained in this section is conducted at least once per year. At least two of the senior managers are present for management reviews. Also, as part of the ISMS annual report, a narrative report of the EMS and its effectiveness is published that addresses each requirement element. The ISMS Description is updated annually to address improvements and lessons learned and to update objectives and targets as necessary and signed by the UCOR president. The environmental policy is also reviewed during the management review annually and revised as necessary.

In addition to the formal annual reviews, monthly reviews of key DOE metrics are submitted to DOE. These metrics relate to the compliance-based EMS objectives and targets. On a periodic basis, the status of EMS objectives and targets are reviewed at the monthly EC&P leader meetings and project meetings as appropriate.

ETTP achieved 24 of 26 environmental targets on schedule in 2011. Highlights included increased recycling and recycling initiatives, 100% purchase of EPEAT silver- or gold-certified computer equipment, zero reportable releases to the environment, zero unpermitted discharges, and zero environmental NOVs.

3.3 Compliance Programs and Status

During 2011, ETTP operations were conducted in compliance with contractual and regulatory environmental requirements with one exception. In 2011, there were two National Pollutant Discharge Elimination System (NPDES) permit noncompliances.

No NOVs or penalties were issued to ETTP operations in 2011. The following sections provide more detail on each compliance program and the activities in 2011.

3.3.1 Environmental Permits

Table 3.2 contains a list of environmental permits that were effective at ETTP in 2011.

3.3.2 Notices of Violations and Penalties

ETTP did not receive any NOVs or penalties from regulators in 2011.

3.3.3 Audits and Oversight

Table 3.3 presents a summary of environmental audits conducted at ETTP in 2011.

3.3.4 National Environmental Policy Act/National Historic Preservation Act

The National Environmental Policy Act (NEPA) provides a means to evaluate the potential environmental impact of proposed federal activities and to examine alternatives to those actions. ETTP maintains compliance with NEPA through the use of site-level procedures and program descriptions that establish effective and responsive communications with program managers and project engineers to ensure NEPA is a key consideration in the formative stages of project planning.

During 2011, ETTP continued to operate under site-level, site-specific procedures that provide requirements for project reviews and NEPA compliance. These procedures call for a review of each proposed project, activity, or facility to determine the potential for impacts to the environment. To streamline the NEPA review and documentation process, DOE ORO has approved generic categorical exclusions (CXs) that cover certain proposed activities (i.e., maintenance activities, facilities upgrades, personnel safety enhancements). A CX is one of a category of actions defined in 40 CFR 1508.4 that does

Table 3.2. East Tennessee Technology Park Environmental Permits, 2011[a]

Regulatory driver	Permit title/description	Permit No.	Issue date	Expiration date	Owner	Operator	Responsible contractor
CAA	Operating permit—Tennessee Air Quality Act for K-1407-U VOC Air Stripper.	045253P	06-20-96	10-01-00	DOE	BJC	BJC
CAA	Operating permit—Tennessee Air Quality Act for K-1425 Waste Oil/Solvent Storage Tank Farm	029895P	09-21-90	10-01-95	DOE	BJC	BJC
CAA	Operating permit—Tennessee Air Quality Act for K-1435-C Liquid Waste Tank Farm	037460P	03-31-94	10-18-98	DOE	BJC	BJC
CAA	Permit to construct—Tennessee Air Quality Act for K-1423 TSCA Solids Waste Repack Facility	958435P	10-10-05	10-10-06	DOE	BJC	BJC
CAA	Permit to construct—Tennessee Air Quality Act for TSCA Incinerator	957808I	01-25-05	Permit surrendered 03-30-10	DOE	BJC	BJC
CWA	NPDES permit for the Central Neutralization Facility Wastewater Treatment System	TN0074225	10-29-10	12-31-13	DOE	UCOR	UCOR
CWA	NPDES permit for storm water discharges	TN0002950	02-26-10	12-31-13	DOE	DOE	UCOR
CWA	State operating permit—Waste Transportation Project; Blair Road and Portal 6 Sewage Pump and Haul Permit	SOP-05068	02-28-06	02-28-09	DOE	URS	URS
CWA	State operating permit—K-1310-DF and K-1310-HG Trailers	SOP-99033	04-29-05	04-29-10	DOE	UCOR	UCOR
CWA	State operating permit—K-1065 Facility; Trailer K-1310-BS added in March 2009	SOP-01042	11-30-06	Terminated 5-31-11	DOE	UCOR	UCOR

Table 3.2. (continued)

Regulatory driver	Permit title/description	Permit No.	Issue date	Expiration date	Owner	Operator	Responsible contractor
CWA	State operating permit—EMWMF. 5,000 gal holding tank and 1,500 gal holding tank	SOP-01043	07-31-07	07-31-12	DOE	UCOR	UCOR
CWA	Authorized/certified USTs at K-1414 Garage	Customer ID 30166 Facility ID 073008	03-20-89	Ongoing	DOE	UCOR	UCOR
RCRA	K-25 Site TSCA Incinerator	TNHW-015	09-28-87	09-28-97	DOE	UCOR	UCOR
RCRA	ETTP Container and Tank Storage and Treatment Units	TNHW-133	09-28-07	09-28-17	DOE	UCOR	UCOR
RCRA	ETTP Container Storage and Treatment Units	TNHW-117	09-30-04	09-30-14	DOE	UCOR	UCOR
RCRA	Hazardous Waste Corrective Action Permit (encompasses the entire ORR)	TNHW-121	09-28-04	09-28-14	DOE	DOE/All[b]	DOE/All[b]
TSCA	TSCA Incinerator PCB treatment authorization	Not applicable	03-20-89	Ongoing	DOE	UCOR	UCOR

[a]In cases where permit renewal applications have been submitted to regulatory agencies in a timely manner but a new permit has not been issued, permission is granted by regulators to continue operating under the terms of the existing but expired permit.

[b]DOE and all ORR co-operators of hazardous waste permits.

Abbreviations

BJC = Bechtel Jacobs, Inc., LLC
CAA = Clean Air Act
CWA = Clean Water Act
DOE = US Department of Energy
EMWMF = Environmental Management Waste Management Facility
ETTP = East Tennessee Technology Park
ID = identification (number)
NPDES = National Pollutant Discharge Elimination System
ORR = Oak Ridge Reservation
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
SOP = state operating permit
TSCA = Toxic Substances Control Act
UCOR = URS | CH2M Oak Ridge LLC
UST = underground storage tank

Table 3.3. Regulatory oversight, assessments, inspections, and site visits at East Tennessee Technology Park, 2011

Date	Reviewer	Subject	Issues
January 14	TDEC	Annual CAA Inspection	0
February 7–8	TDEC	Annual RCRA Compliance Inspection	0
June 28	TDEC-Nashville	TSCA PCB Inspection	0
September 21	TDEC-Knoxville	CNF NPDES compliance evaluation inspection	0
October 7	EPA	TSCA Incinerator—PCB site visit	0

Abbreviations
CAA = Clean Air Act
CNF = Central Neutralization Facility
EPA = US Environmental Protection Agency
NPDES = National Pollutant Discharge Elimination System
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
TDEC = Tennessee Department of Environment and Conservation
TSCA = Toxic Substances Control Act

not individually or cumulatively have a significant effect on the human environment and for which neither an environmental assessment nor an environmental impact statement is normally required. UCOR activities on ORR are in full compliance with NEPA requirements, and procedures for implementing NEPA requirements have been fully developed and implemented. At ETTP, a checklist incorporating NEPA and EMS requirements has been developed as an aid for project planners. For routine operations, generic CXs have been issued. During 2011 one CX was issued (ETTP Airport Feasibility Study), and 11 review reports (all for reindustrialization projects) were prepared. A review report is generated when a NEPA review is conducted and the activity is found to fall within one of the DOE ORO generic CXs.

Compliance with the National Historic Preservation Act (NHPA) at ETTP is achieved and maintained in conjunction with NEPA compliance. The scope of proposed actions is reviewed in accordance with the *Cultural Resource Management Plan* (DOE 2001). At ETTP, there are 135 facilities eligible for inclusion on the National Register of Historic Places. To date, more than 220 facilities have been demolished. Artifacts of historical and/or cultural significance are identified before demolition and are cataloged in a database to aid in historic interpretation of ETTP.

3.3.5 Clean Air Act Compliance Status

The Clean Air Act (CAA), passed in 1970 and amended in 1977 and 1990, forms the basis for the national air pollution control effort. This legislation establishes comprehensive federal and state regulations to limit air emissions and includes five major regulatory programs: the National Ambient Air Quality Standards, State Implementation Plans, New Source Performance Standards (NSPSs), Prevention of Significant Deterioration (PSD) permitting programs, and National Emission Standards for Hazardous Air Pollutants (NESHAP). Airborne discharges from DOE Oak Ridge facilities, both radioactive and nonradioactive, are subject to regulation by EPA and the TDEC Division of Air Pollution Control.

In 2011, all ETTP sources discharging airborne pollutants operated in full compliance with regulations. There were no sources that required any form of continuous emissions monitoring during 2011. Six radionuclide sources operated during 2011, each with the potential impact of less than 0.1 mrem on any member of the public over a 12-month period. All other operations demonstrated compliance with other generally applicable air quality protection requirements (asbestos, stratospheric ozone, etc.). TDEC personnel performed one inspection of ETTP CAA permitted operations in 2011. No issues or concerns were noted by the TDEC inspector. In summary, there were no ETTP CAA violations or exceedances in 2011. Section 3.4 provides detailed information on 2011 ETTP activities conducted in support of CAA.

3.3.6 Clean Water Act Compliance Status

The objective of CWA is to restore, maintain, and protect the integrity of the nation's waters. This act serves as the basis for comprehensive federal and state programs to protect the waters from pollutants (see Appendix C for water reference standards). One of the strategies developed to achieve the goals of CWA was EPA's establishment of limits on specific pollutants allowed to be discharged to US waters by municipal sewage treatment plants and industrial facilities. EPA established the NPDES permitting program to regulate compliance with pollutant limitations. The program was designed to protect surface waters by limiting effluent discharges into streams, reservoirs, wetlands, and other surface waters. EPA has delegated authority for implementation and enforcement of the NPDES program to the State of Tennessee. ETTP discharges to the waters of the state of Tennessee under two individual NPDES permits:

- NPDES permit number TN0002950, which regulates storm water discharges, and
- NPDES permit numberTN0074225, which regulates industrial discharges from the Central Neutralization Facility (CNF).

In 2011, compliance with ETTP NPDES storm water permit TN0002950 was determined by about 420 laboratory analyses, field measurements, and flow estimates. The NPDES permit compliance rate for all discharge points for 2011 was nearly 100%. Two NPDES permit noncompliances occurred in CY 2011. On March 21, 2011, an employee observed a discharge from sanitary sewer lift station K-1204-15 at CNF into a nearby storm water inlet. This lift station collects sanitary sewage discharges from CNF and from a break trailer located within the CNF area. Storm water from this area discharges to Mitchell Branch via storm water Outfall 170. A walkdown of Mitchell Branch was conducted, and no evidence of a fish kill or any other type of damage to the aquatic ecosystem of the stream was observed. No threat to human health or the environment occurred as a result of this discharge. No physical evidence of the discharge could be observed at the outfall. On April 12, 2011, sampling subcontractor personnel were collecting routine NPDES permit compliance data at storm water Outfall 690. They obtained a pH reading of 9.6 standard units at the designated NPDES monitoring location for that outfall. The pH reading of 9.6 standard units is outside the NPDES permitted range of 6.0–9.0 standard units for this outfall. It is believed that storm water infiltrated through concrete debris and rubble that were generated during the demolition of the K-33 building. The pH of the storm water may have been raised by contact with this material. No threat to human health or the environment occurred as a result of this discharge.

In 2011, compliance with the ETTP NPDES permit for industrial wastewater from CNF was determined by more than 2000 laboratory analyses and field measurements. The CNF NPDES permit compliance rate for 2011 was 100% with no noncompliances.

The K-1407 Wastewater Treatment System did not operate in 2011. It is not expected to operate in the future.

3.3.7 Safe Drinking Water Act Compliance Status

ETTP's water distribution system is designated as a nontransient, noncommunity water system by TDEC's Division of Water Supply. The *Tennessee Regulations for Public Water Systems and Drinking Water Quality*, Chap. 1200-5-1 (TDEC 2009), sets limits for biological contaminants and for chemical activities and chemical contaminants. TDEC requires sampling for the following constituents for compliance with state and federal regulations:

- chlorine residual levels,
- bacteriological (total coliform),
- lead and copper, and
- disinfectant by-products (trihalomethanes and haloacetic acids).

The city of Oak Ridge supplies potable water to the ETTP water distribution system. The water treatment plant, located on ORR, southwest of ETTP, is owned and operated by the city of Oak Ridge.

3.3.8 Resource Conservation and Recovery Act Compliance Status

ETTP is regulated as a large-quantity generator of hazardous waste because the facility generates more than 1,000 kg of hazardous waste per month. This amount includes hazardous waste generated under permitted activities (including repackaging or treatment residuals). At the end of 2011, ETTP had four generator accumulation areas for hazardous or mixed waste.

Level of hexavalent chromium in Mitchell Branch was reduced from 0.025 mg/L to current levels that are below method detection thresholds of 0.012 mg/L. Details are provided in Section 3.5.5.6.

ETTP is also regulated as a handler of universal waste (e.g., fluorescent lamps, batteries, and other items regulated under 40 CFR 273). Mercury-containing equipment at ETTP is managed as universal waste.

Additionally, some batteries are managed according to 40 CFR Part 266.80. This applies to the management of spent lead-acid batteries that are being reclaimed.

ETTP is registered as a large-quantity generator under EPA identification (ID) number TN0 890 090 004 and is permitted to transport hazardous wastes and to operate RCRA-permitted hazardous waste treatment and storage units. During 2011, eight units operated as permitted units.

ETTP's RCRA storage and treatment facilities (or units) operate under three permits: TNHW-117, TNHW-133, and TNHW-015. The permits are modified when necessary. TDEC approved one permit modification in 2011, and two closure certifications (TNHW-015 and TNHW-133) are awaiting approval. Combustion operations at the Toxic Substances Control Act (TSCA) Incinerator ceased in December 2009. Operations in 2011 centered on decontamination and decommissioning activities (see Section 3.8.1). All RCRA operations at ETTP were in compliance with permit requirements during 2011.

3.3.9 Resource Conservation and Recovery Act Underground Storage Tanks

USTs containing petroleum and hazardous substances are regulated under Subtitle I of RCRA (40 CFR 280). EPA granted TDEC authority to regulate USTs containing petroleum under TDEC Rule 1200-1-15; however, EPA still regulates hazardous-substance USTs.

ETTP has two USTs registered with TDEC under facility ID number 0730088. All RCRA UST operations at ETTP were in compliance with permit requirements during 2011.

3.3.10 Comprehensive Environmental Response, Compensation, and Liability Act Compliance Status

CERCLA, also known as Superfund, was passed in 1980 and was amended in 1986 by the Superfund Amendments and Reauthorization Act (SARA). Under CERCLA, a site is investigated and remediated if it poses significant risk to health or the environment. The EPA National Priorities List (NPL) is a comprehensive list of sites and facilities that have been found to pose a sufficient threat to human health and/or the environment to warrant cleanup under CERCLA.

In 1989, ORR was placed on NPL. In 1992, the ORR FFA among EPA, TDEC, and DOE became effective and established the framework and schedule for developing, implementing, and monitoring remedial actions on ORR. ETTP's primary mission is D&D of surplus facilities. The on-site CERCLA EMWMF, located in Bear Creek Valley, is used for disposal of contaminated waste resulting from CERCLA cleanup actions on ORR. EMWMF is an engineered landfill that accepts low-level radioactive, hazardous, asbestos, and polychlorinated biphenyl (PCB) wastes and combinations of the aforementioned wastes in accordance with specific waste acceptance criteria under an agreement with state and federal regulators. Uncontaminated CERCLA waste is disposed of at the ORR sanitary landfill.

3.3.10.1 East Tennessee Technology Park RCRA-CERCLA Coordination

The ORR FFA is intended to coordinate the corrective action processes of RCRA required under the Hazardous and Solid Waste Amendments permit with CERCLA response actions.

RCRA groundwater monitoring data are reported yearly to TDEC and EPA in the annual remediation effectiveness report for ORR (DOE 2011).

Periodic updates of proposed construction and demolition activities and facilities at ETTP have been provided to managers and project personnel from the TDEC DOE Oversight Division and EPA Region 4. A CERCLA screening process is used to identify proposed construction and demolition projects and facilities that warrant CERCLA oversight. The goal is to ensure that modernization efforts do not adversely impact the effectiveness of previously completed CERCLA environmental remedial actions or future CERCLA environmental remedial actions.

3.3.11 Toxic Substances Control Act Compliance Status

3.3.11.1 Polychlorinated Biphenyls

On April 3, 1990, DOE notified EPA headquarters (as required by 40 CFR 761.205) that ETTP is a generator with on-site storage, a transporter, and an approved disposer of PCB wastes.

PCB waste generation, transportation, disposal, and storage at ETTP are regulated under EPA ID number TN0890090004. In 2011, ETTP operated about 10 PCB waste storage areas in ETTP generator buildings and, when longer-term storage of PCB/radioactive wastes was necessary, RCRA-permitted storage buildings. The continued use of authorized PCBs in electrical systems and/or equipment (e.g., transformers, capacitors, rectifiers) is regulated at ETTP. At this time, there is no PCB-contaminated electrical equipment in service at ETTP. Most TSCA-regulated equipment at ETTP has been disposed of. However, some ETTP facilities continue to use or store for future reuse PCB-contaminated equipment.

Because of the age of many of ETTP's facilities and the varied uses for PCBs in gaskets, grease, building materials, and equipment, DOE self-disclosed unauthorized use of PCBs to EPA in the late 1980s. As a result, the DOE Oak Ridge Office and EPA Region 4 consummated a major compliance agreement known as the *Oak Ridge Reservation Polychlorinated Biphenyl Federal Facilities Compliance Agreement* (DOE 2012a), which became effective December 16, 1996, and was last revised on May 23, 2012. The agreement specifically addresses the unauthorized use of PCBs in ventilation ducts and gaskets, lubricants, hydraulic systems, heat transfer systems, and other unauthorized uses; storage for disposal; disposal; cleanup and/or decontamination of PCBs and PCB items including PCBs mixed with radioactive materials; and ORR records and reporting requirements. A major focus of the agreement is the disposal of PCB waste. As a result of that agreement, DOE and UCOR continue to notify EPA when additional unauthorized uses of PCBs, such as PCBs in paint, adhesives, electrical wiring, or floor tile, are identified at ETTP.

ETTP is home to the TSCA Incinerator (Fig. 3.8). On December 2, 2009, the TSCA Incinerator ceased operations as a waste incinerator and transitioned to a facility closure and decommissioning mode. The RCRA and PCB closure certification report for the TSCA Incinerator RCRA Permitted Unit areas was submitted to EPA and TDEC on June 10, 2011. The Closure Certification Report is still under review by TDEC and EPA Region 4 regulatory groups.

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Fig. 3.8. Toxic Substances Control Act Incinerator.

During the remainder of 2011, the primary focus at the TSCA Incinerator was preparing the permit by rule components of the TSCA Incinerator facility for RCRA and TSCA closure so the facility could go into a surveillance and maintenance mode later in the year.

3.3.12 Emergency Planning and Community Right-to-Know Act Compliance Status

The Emergency Planning and Community Right-to-Know Act (EPCRA) and Title III of SARA require that facilities report inventories and releases of certain chemicals that exceed specific release thresholds. The reports are submitted to the local emergency planning committee and the state emergency response commission. ETTP complied with these requirements in 2011 through the submittal of reports under EPCRA Sections 302, 303, 311, and 312. ETTP had no releases of extremely hazardous substances, as defined by EPCRA, in 2011.

3.3.12.1 Material Safety Data Sheet/Chemical Inventory (EPCRA Section 312)

Inventories, locations, and associated hazards of hazardous and extremely hazardous chemicals were submitted in an annual report to state and local emergency responders as required by EPCRA Section 312 requirements. Of the ORR chemicals identified for 2011, 16 were located at ETTP.

Private-sector lessees associated with the reindustrialization effort were not included in the 2011 submittals. Under the terms of their leases, lessees must evaluate their own inventories of hazardous and extremely hazardous chemicals and must submit information as required by the regulations. In 2011, the reported materials include Sakrete (type “N” or type “S”), rock salt (for road maintenance), sand (for road maintenance), and lead metal (largely in the form of lead-acid batteries). BJC submitted its EPCRA 312 Report in February 2011.

3.3.12.2 Toxic Chemical Release Reporting (EPCRA Section 313)

DOE submits annual toxic release inventory (TRI) reports to EPA and TDEC on or before July 1 of each year. The reports cover the previous calendar year and address releases of certain toxic chemicals to air, water, and land and waste management, recycling, and pollution prevention activities. Threshold determinations and reports for each of the ORR facilities are made separately. Operations involving TRI chemicals were compared with regulatory thresholds to determine which chemicals exceeded the reporting thresholds based on amounts manufactured, processed, or otherwise used at each facility. After threshold determinations were made, releases and off-site transfers were calculated for each chemical that exceeded one or more of the thresholds. In 2011, the only chemicals that met the reporting requirements were diisocyanates associated with foaming activity to stabilize deposits in pipes undergoing remediation actions. The TRI report was submitted as required in June 2011.

3.4 Air Quality Program

The State of Tennessee has been relegated authority by EPA to convey the clean air requirements that are applicable to ETTP operations. New projects are governed by construction and operating permit regulatory requirements. The owner or operator of air pollutant emitting sources is responsible for ensuring full compliance with any issued permit or other generally applicable CAA requirement. During 2011, ETTP DOE EM operations transitioned from BJC to UCOR, and UCOR assumed responsibility for regulatory compliance.

Up until the closure and surrender of the air permit for the TSCA Incinerator in March 2010, ETTP was subject to sitewide Title V permitting requirements under CAA. EM operations at ETTP no longer require the sitewide permit, and all existing sources continued to operate compliantly in 2011 under Tennessee Air Pollution Control Regulations (TAPCR) 1200-3. All operations are still subject to all generally applicable requirements. Examples include requirements associated with control of asbestos, control of stratospheric ozone-depleting chemicals, and control of fugitive emissions. Other major requirements include 40 CFR 61, NESHAP for radionuclides (Rad-NESHAP), and the numerous requirements associated with ensuring emissions of criteria pollutants, hazardous air pollutants (HAPs), and all other regulated pollutants are below any threshold levels that would require permitting.

Ambient air monitoring, while not generally required by a condition of a permit or other CAA regulation, is conducted at ETTP to satisfy DOE order requirements, as a best-management practice, and/or to provide evidence of sufficient programmatic control of certain emissions. Ambient air monitoring conducted at ETTP is supplemented by additional monitoring conducted by UT-Battelle and by both on-site and off-site monitoring conducted by TDEC. In addition, compliance with CAA is ensured using a management program that includes internal audits and external audits such as the annual inspection conducted by State of Tennessee personnel.

3.4.1 Construction and Operating Permits

During 2011, all remaining air permits under BJC responsibility were surrendered to TDEC before the transition to UCOR. Notification to rescind the on-file ETTP Title V Major Source Operating Permit Application was submitted to TDEC. Effective June 30, 2011, no remaining ETTP operation under UCOR responsibility was subject to permitting.

At the beginning of 2011, there were four active operating permits for ETTP air emission sources under BJC operations. Two of the permits were for tank farms used to receive, store, blend, and feed liquid wastes into the TSCA Incinerator. Following the permanent shutdown of the TSCA Incinerator in 2010, no new wastes were processed through these facilities during 2011 and they were permanently disabled. The K-1423 Solid Waste Repacking Facility was permitted due to potential radionuclide emission levels. Compliance was demonstrated using the EPA-approved method of ambient air monitoring. Waste processing in this facility ceased in September 2009; the facility was permanently disabled and did not operate during 2011. The K-1407 CNF volatile organic compound (VOC) air stripper was permitted for total VOC emissions. Compliance was demonstrated by monitoring total wastewater processed and the results of wastewater influent sampling. A review of CNF to release air pollutants was performed during 2011. It was determined that the maximum potential to emit was well below any level that would require permitting. One new source, the K-1407-AL Chromium Water Treatment System (CWTS), initiated operations at the end of 2011. CWTS incorporates an air stripper to remove VOCs from the effluent stream before discharge of treated water. A review of CWTS emissions demonstrated that they were well below any level that would require permitting. All facilities operated in full compliance with all generally applicable CAA requirements during 2011.

3.4.1.1 Generally Applicable Permit Requirements

ETTP is subject to a number of generally applicable requirements that involve management and control. Asbestos, ozone-depleting substances, and fugitive particulate emissions are specific examples.

3.4.1.1.1 Control of Asbestos

ETTP’s asbestos management program ensures all activities involving demolitions and all other actions impacting asbestos-containing materials (ACMs) are fully compliant with 40 CFR 61, Subpart M. This includes using approved engineering controls and work practices, inspections, and monitoring for proper removal and waste disposal of ACMs. ETTP has numerous buildings and equipment that contain ACMs. Major demolition activities during 2011 involved the abatement of significant quantities of ACMs that were subject to the requirements of 40 CFR 61, Subpart M. Most demolition and ACM abatement activities are governed under CERCLA. Under this act, notifications of asbestos demolition or renovations as specified in 40 CFR 61.145(b) are incorporated into CERCLA document regulatory notifications. All other non-CERCLA planned demolition or renovation activities were individually reviewed for applicability of the TDEC notification requirements of the rule. The rule also requires an annual notification for all nonscheduled minor asbestos renovations if the accumulated total amount of regulated or potentially regulated asbestos exceeds stipulated thresholds. For 2011 the total projected nonscheduled amounts were below thresholds that would require the submittal of an annual notification to TDEC. No releases of reportable quantities of ACMs occurred at ETTP during 2011.

3.4.1.1.2 Stratospheric Ozone Protection

The management of ozone-depleting substances (ODS) at ETTP is subject to regulations in 40 CFR Part 82, Subpart F, Recycling and Emissions Reduction; these regulations require preparation of documentation to establish that actions necessary to reduce emissions of Class I and Class II refrigerants to the lowest achievable level have been observed during maintenance activities at ETTP. The applicable actions include, but may not be limited to, the service, maintenance, repair, and disposal of appliances containing Class I and Class II refrigerants, including motor vehicle air-conditioners. In addition, the regulations apply to refrigerant reclamation activities, appliance owners, manufacturers of appliances, and recycling and recovery equipment.

A review is conducted annually that documents the use of ODS at ETTP, the regulatory requirements for management of ODS, and the mechanisms that demonstrate compliance with 40 CFR 82.166. This review does not address the private entities on ETTP.

There were no purchases of Class I (R-12) and Class II (R-22) refrigerants for servicing ETTP chiller units and small appliances during 2011. There were five purchases of alternative refrigerants (R-134a) totaling 127 lb during 2011 to replenish the existing inventory.

The inventory as of December 31, 2011, from the Hazardous Materials Information System, totaled 90 lb of Class I, 260 lb of Class II, and 361 lb of alternative refrigerants (R-134a, R-402b, R-404a, R-410, and R-502). Figure 3.9 demonstrates the effect of ongoing actions that are eliminating or reducing the use of all refrigerants including Class I and Class II at ETTP. Upon completion of current and future major facility demolition and remediation actions, this total inventory should decline as refrigeration equipment in these facilities is permanently removed from service.

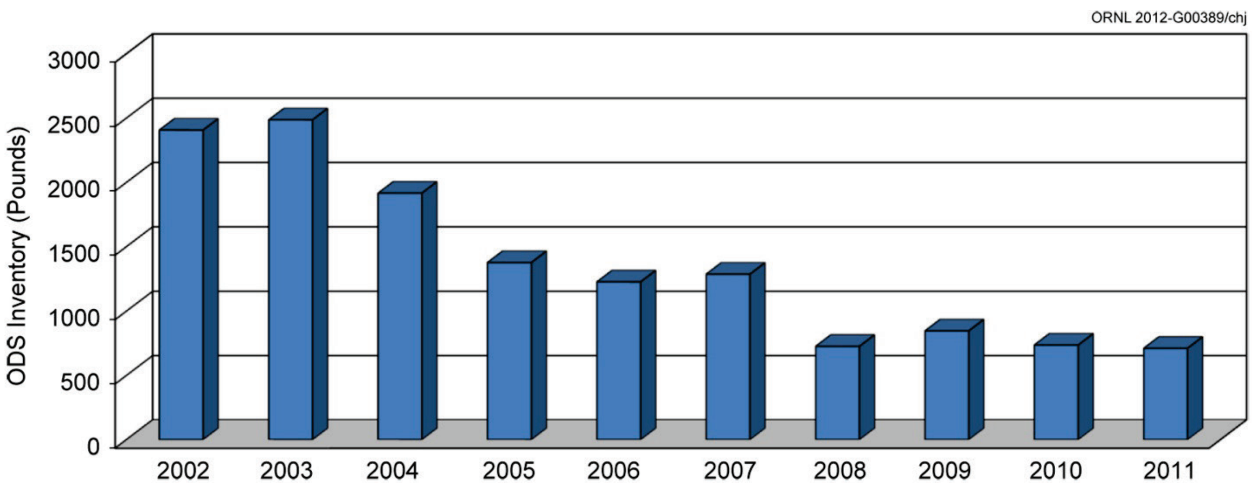

Fig. 3.9. East Tennessee Technology Park total on-site ozone-depleting substance inventory history.

3.4.1.1.3 Fugitive Particulate Emissions

ETTP has been the location of major building demolition activities and waste debris transportation with the potential for the release of fugitive dust. All planned and ongoing activities include the use of dust control measures to minimize the release of visible fugitive dust beyond the project perimeter. This includes the use of specialized demolition equipment and water misters. Gravel roads in and around ETTP that are under DOE control are wetted as needed to minimize airborne dusts caused by vehicle traffic.

3.4.1.2 Radionuclide National Emission Standards for Hazardous Air Pollutants

Radionuclide airborne emissions from ETTP are regulated under 40 CFR 61, National Emission Standards for Hazardous Air Pollutants: Department of Energy Facilities (Rad-NESHAP). Characterization of the impact on public health of radionuclides released to the atmosphere from ETTP operations was accomplished by conservatively estimating the dose to the maximally exposed member of the public. The dose calculations were performed using the Clean Air Assessment Package (CAP-88) computer codes, which were developed under EPA sponsorship for use in demonstrating compliance with the 10 mrem/year effective dose (ED) Rad-NESHAP emission standard for the entire DOE ORR. Source emissions used to calculate the dose are determined using EPA-approved methods that can range from continuous sampling systems to conservative estimations based on process and waste characteristics. Continuous sampling systems are required for radionuclide-emitting sources that have the potential dose impact of not less than 0.1 mrem per year to any member of the public. The K-1423 Solid Waste Repack Facility (K-1423) was the only ETTP source remaining that required a continuous sampling system. With EPA approval, ambient air sampling was used for K-1423 Rad-NESHAP compliance in lieu of in-stack continuous sampling. This source did not operate during 2011 and has been permanently shut down. ETTP Rad-NESHAP sources—the K-1407 CNF VOC Air Stripper; K-1407 CWTS VOC Air Stripper; K-2527-BR Grouting Facility; and K-2500-H Segmentation Shops A, C, and D—are considered minor based on emissions evaluations using EPA-approved calculation methods. A minor Rad-NESHAP source is defined as having a potential dose impact on the public not in excess of 0.1 mrem/year.

Compliance is demonstrated using environmental sampling methods allowed in the EPA-approved *Rad-NESHAP Compliance Plan on the Oak Ridge Reservation* (DOE 2005) for determining the dose impacts on members of the public. Figure 3.10 displays the K11 historical dose impact that would represent impact to an on-site member of the public most exposed to all radionuclide emission sources. The upward dose trend from 2010 through 2011 is coincidental to the close proximity of demolition and remediation of radiologically contaminated buildings and burial grounds. For 2011, the dose at this location was 0.19 mrem. This station collects samples that are potentially impacted by all ETTP sources of radionuclide emissions, including both stack and fugitive emissions. This ensures reporting a conservative dose impact to an actual on-site member of the public.

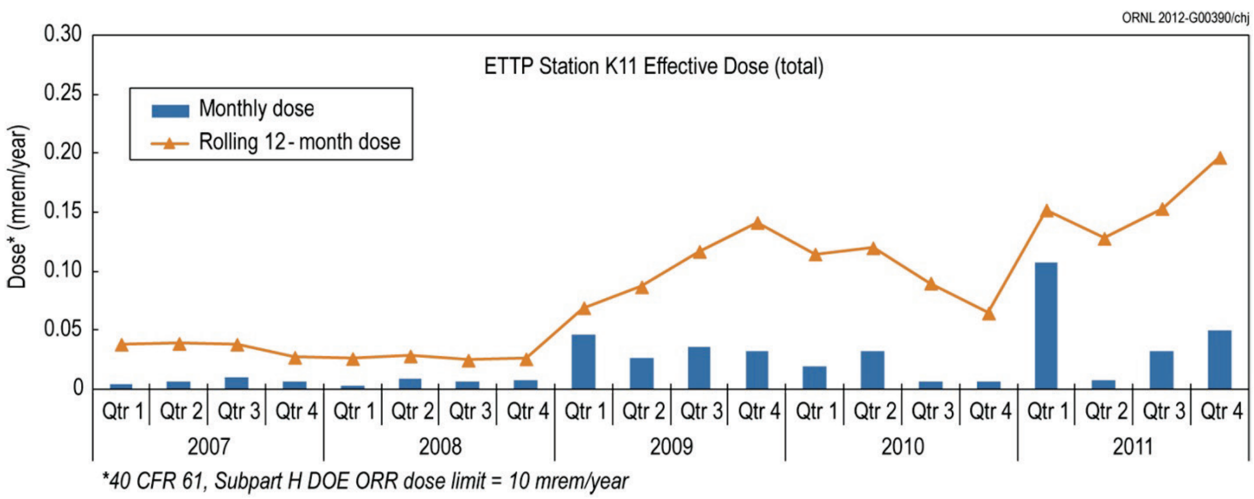

Fig. 3.10. Station K11 radionuclide monitoring results: 5-year rolling, 12-month dose history.

All ETTP sources combined are far below the 10 mrem/year ED, which is the Rad-NESHAP regulatory limit and the applicable standard for combined radionuclide emissions from all ORR facilities. Emissions from all ETTP stationary sources of radionuclides are included in the annual dose assessment report submitted by June 30 of each year as required under Rad-NESHAP regulations. For the 2011 reporting year, the total ORR ED was 0.3 mrem. The total ED contribution from all ETTP stationary source radionuclide emissions was 0.0004 mrem or 0.13% of the total ORR dose.

3.4.1.3 Quality Assurance

QA activities for the Rad-NESHAP program are documented in the *Quality Assurance Program Plan for Compliance with Radionuclide National Emission Standards for Hazardous Air Pollutants*. The plan satisfies the QA requirements in 40 CFR 61, Method 114, for ensuring that the radionuclide air emission measurements from ETTP are representative of known levels of precision and accuracy and that administrative controls are in place to ensure prompt response when emission measurements indicate an increase over normal radionuclide emissions. The requirements are also referenced in TDEC regulation 1200-3-11-08. The plan ensures the quality of ETTP radionuclide emission measurement data from continuous samplers and minor radionuclide release points. Only EPA preapproved methods are referenced through the *Rad-NESHAP Compliance Plan on the Oak Ridge Reservation* (DOE 2005).

3.4.1.4 Greenhouse Gas Emissions

The EPA mandatory reporting of GHGs rule was enacted September 30, 2009, under 40 CFR 98.2. According to the rule in general, the stationary source emissions threshold for reporting requirement is 25,000 metric tons or more of GHGs per year (CO_2 equivalents per year). The rule defines GHGs as follows:

- carbon dioxide (CO_2),
- methane (CH_4),
- nitrous oxide (N_2O),
- hydrofluorocarbons,
- perfluorocarbons, and
- sulfur hexafluoride (SF_6).

A review was performed of ETTP processes and equipment categorically identified under 40 CFR 98.2 whose emissions must be included as part of a facility annual GHG report starting with the calendar year 2010 reporting period. Based on total GHG emissions from all ETTP stationary sources during 2011, ETTP did not exceed the annual threshold limit and therefore was not subject to mandatory annual reporting under the GHG rule for the 2011 reporting period. The total GHG emissions for any continuous 12-month period beginning with calendar year 2008 have not exceeded 12,390 metric tons of GHGs. The decrease in stationary source emissions is due to the permanent shutdown of the TSCA Incinerator. The remaining sources are predominantly small comfort heating systems, hot water systems, and power generators. Figure 3.11 shows the historical trend of ETTP total GHG stationary emissions including contributions from the TSCA Incinerator. For the 2011 calendar year period, GHG emissions totaled only 307 metric tons.

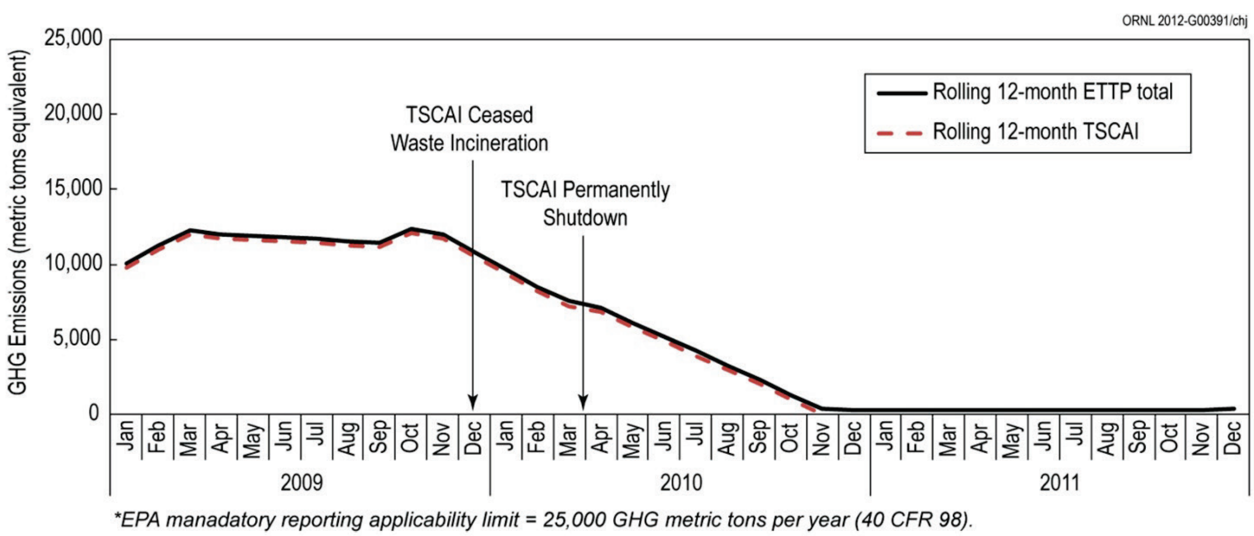

Fig. 3.11. East Tennessee Technology Park stationary source greenhouse gas (GHG) emissions tracking history. (TSCAI = Toxic Substances Control Act Incinerator.)

EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance,* was signed by President Obama on October 5, 2009. The purpose of this order is to establish policies for federal facilities that will increase energy efficiency; measure, report, and reduce GHG emissions from direct and indirect activities; conserve and protect water resources through efficiency, reuse, and storm water management; and eliminate waste, recycle, and prevent pollution at all federal facilities. While the order deals with a number of environmental media, only its applicability to GHGs is considered here. The EO defines three distinct scopes for purposes of reporting. Scope 1 is essentially direct GHG emissions from sources that are owned or controlled by the federal agency; Scope 2 encompasses GHG emissions resulting from the generation of electricity, heat, or steam purchased by a federal agency; and Scope 3 involves GHG emissions from sources not owned or directly controlled by a federal agency but related to agency activities such as vendor supply chains, delivery services, and employee business travel and commuting. Figure 3.12 displays the fiscal year trend toward the 28% total Scope 1 and 2 GHG emissions reduction target by 2020, as stated in the DOE *Strategic Sustainability Performance Plan* (DOE 2010). Figure 3.13 shows the relative contribution of each of the three major scopes at ETTP to the FY 2011 GHG emissions.

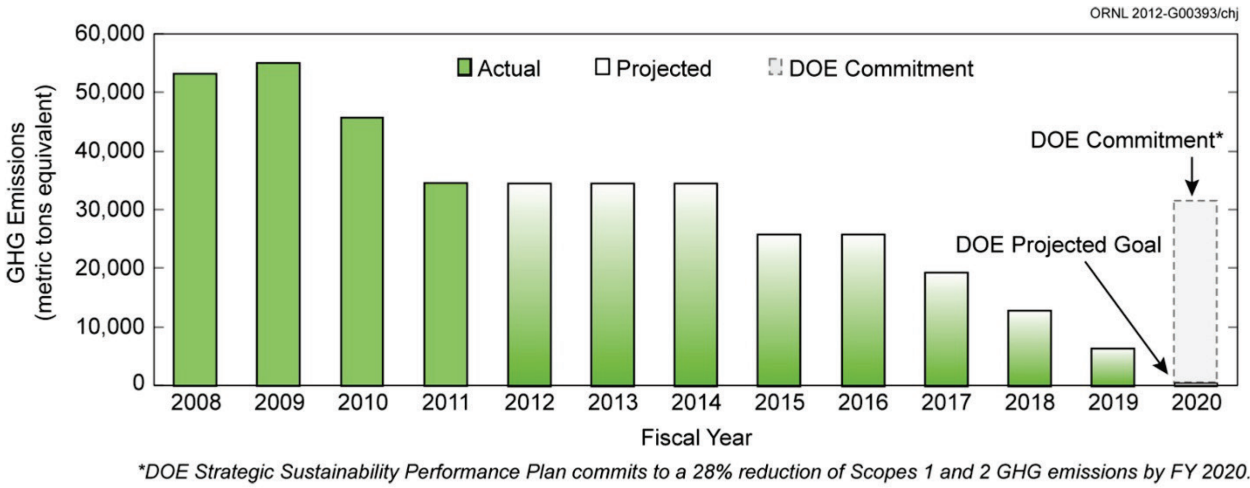

Fig. 3.12. East Tennessee Technology Park greenhouse gas (GHG) emissions trend and targeted reduction commitment.

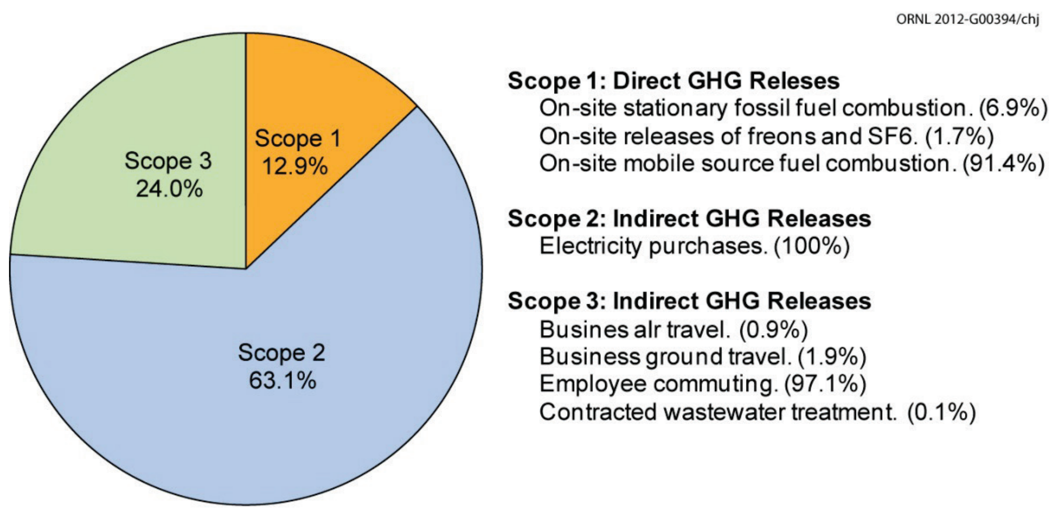

Fig. 3.13. Fiscal year 2011 East Tennessee Technology Park greenhouse gas (GHG) contribution of each scope.

3.4.1.5 Source-Specific Criteria Pollutants

ETTP operations up until July 1, 2011, included only one functioning stationary source with permit restrictions for any form of air pollutant emissions: the CNF VOC air stripper. Beginning July 1, 2011, potential emissions from any remaining stationary sources are below any level that would require permitting. All process data records and the calculated maximum VOC emission rate for the CNF air stripper were within permit limits for 2011. The calculated maximum VOC emission rate was only 0.13 lb/h compared to an influent limit of 1.0 lb/h. All other stationary sources were evaluated and determined to have emissions levels below the levels that require permitting.

ETTP operations released airborne pollutants from a variety of minor pollutant-emitting sources such as stacks, vents, and fugitive and diffuse activities. The emissions from all stack and vent emissions are calculated following approved methods to establish their low emissions potential. This is done to document the verification of their minor source permit exempt status under all applicable state and federal regulations.

3.4.1.6 Hazardous Air Pollutants (Nonradionuclide)

Unplanned releases of HAPs are regulated through the risk management planning regulations. ETTP personnel have determined that there are no processes or facilities containing inventories of chemicals in quantities exceeding thresholds specified in rules pursuant to CAA, Title III, Sect. 112(r), "Prevention of Accidental Releases." Therefore, activities at ETTP are not subject to the rule. Procedures are in place to continually review new processes, process changes, or activities with the rule thresholds.

3.4.2 Ambient Air

Compliance of fugitive and diffuse sources is demonstrated based on environmental measurements. The ETTP Ambient Air Quality Monitoring Program is designed to provide environmental measurements to accomplish the following:

- track long-term trends of airborne concentration levels of selected air contaminant species;
- measure the highest concentrations of the selected air contaminant species that occur in the vicinity of ETTP operations, and
- evaluate the impact of air contaminant emissions from ETTP operations on ambient air quality.

The sampling stations in the ETTP area are designated as base, supplemental, or ORR perimeter air monitoring (PAM) stations. Figure 3.14 shows the locations of all ambient air sampling stations in and around ETTP that were active during the 2011 reporting period. The base program consists of two locations using high-volume ambient air samplers. Supplemental locations are typically temporary, project-specific stations that use samplers specific to a type of potential emissions. Samplers typically include high-volume systems, depending on the source emission evaluation of the project. All base, supplemental, and PAM samplers operate continuously with exposed filters collected weekly.

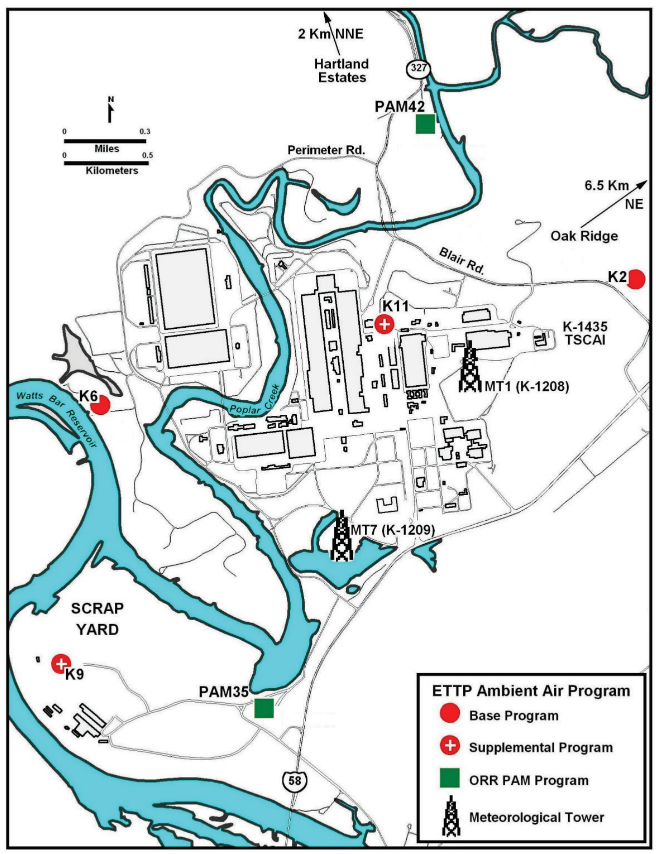

Fig. 3.14. East Tennessee Technology Park ambient air monitoring station locations.

The radiological monitoring results for samples collected at the two ETTP area PAM stations were provided by UT-Battelle staff and are included in the ETTP network results for comparative purposes. Figure 3.15 shows an example of a typical ETTP air monitoring station.

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Fig. 3.15. East Tennessee Technology Park ambient air monitoring station.

The analytical parameters were chosen with regard to existing and proposed regulations and with respect to activities at ETTP. Supplemental station K9 covered the remediation activities in the K-770 scrapyard area that had the potential to produce fugitive airborne emissions. Supplemental station K11 is located to demonstrate compliance with radiological emissions from K-1423. Changes of emissions from ETTP will warrant periodic reevaluation of the parameters being sampled. Ongoing ETTP reindustrialization efforts also introduce new locations for members of the public that may require adding or relocating monitoring site locations. To ensure understanding of the potential impact on the public and to establish any required emissions monitoring and emissions controls, a survey of all on-site tenants is conducted at least every 6 months.

All base and supplemental stations collect continuous samples for radiological and selected metals analyses. Inorganic analytical techniques are used to test samples for the following nonradiological pollutants: As, Be, Cd, Cr, Pb, and total uranium. Radiological analyses of samples from the ETTP stations test for the isotopes ^{237}Np, ^{238}Pu, ^{239}Pu, ^{99}Tc, ^{234}U, ^{235}U, and ^{238}U; ORR station sampling results for ^{234}U, ^{235}U, and ^{238}U were provided by UT-Battelle and are included with ETTP results.

Figures 3.16a through 3.16e illustrate the air concentrations of As, Be, Cd, Cr, and Pb for the past 5 years based on quarterly composites of weekly continuous samples. All samples were analyzed by the inductively coupled plasma–mass spectrometer (ICP-MS) analytical technique. The results are compared with applicable air quality standards for each pollutant. The annualized levels of As, Be, Cd, and Pb were well below the indicated annual standards. With some exceptions results for 2011 annual averages are all generally lower than results reported for 2010. The quarterly variations for some pollutants show a wider variation during 2011 as compared to 2010. Arsenic levels during the third quarter of 2011, show a peak similar to previous historical periods. Beryllium levels are very similar to previous years. Cadmium levels are well within historical variations. Variations in chromium during 2011 follow similar trends that were coincidental to the demolition of large concrete slabs of demolished ETTP structures. The upward trend of lead concentration levels is coincidental to a large increase in diesel powered motor vehicles and equipment in the vicinity of Station K11.

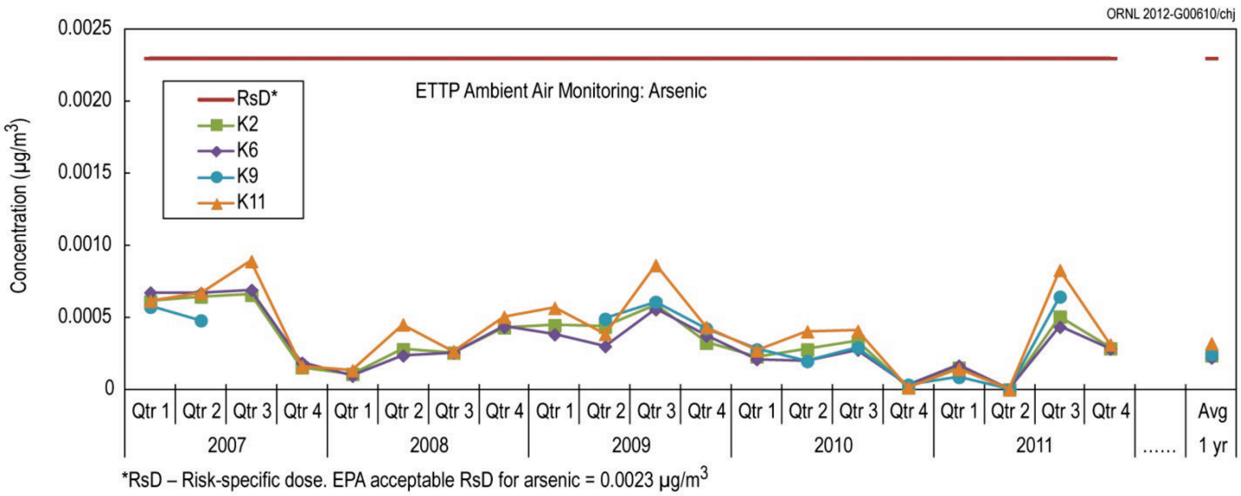


Fig. 3.16a. Arsenic monitoring results: 5-year history through 2011.

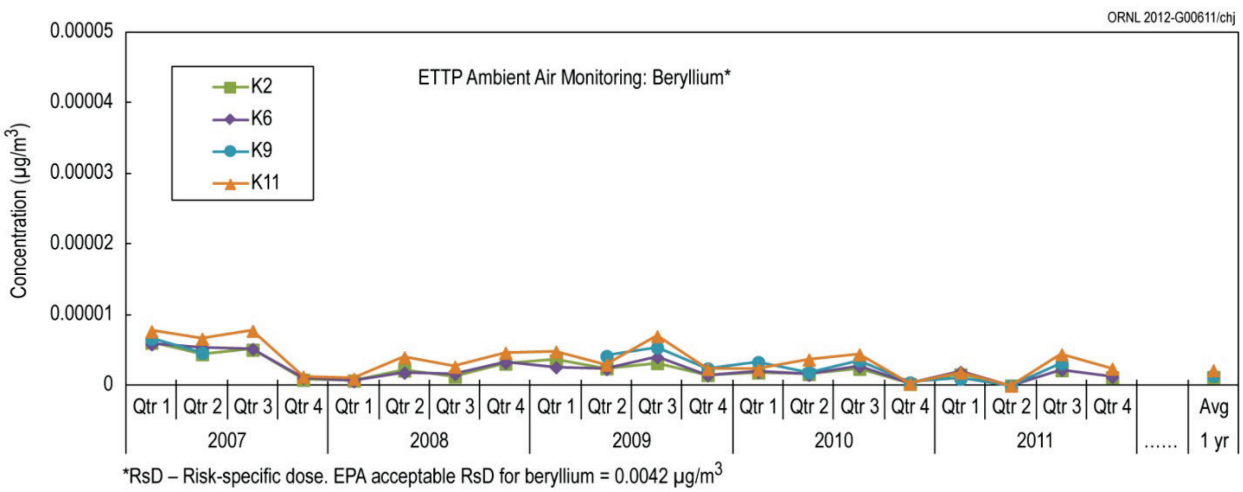


Fig. 3.16b. Beryllium monitoring results: 5-year history through 2011.

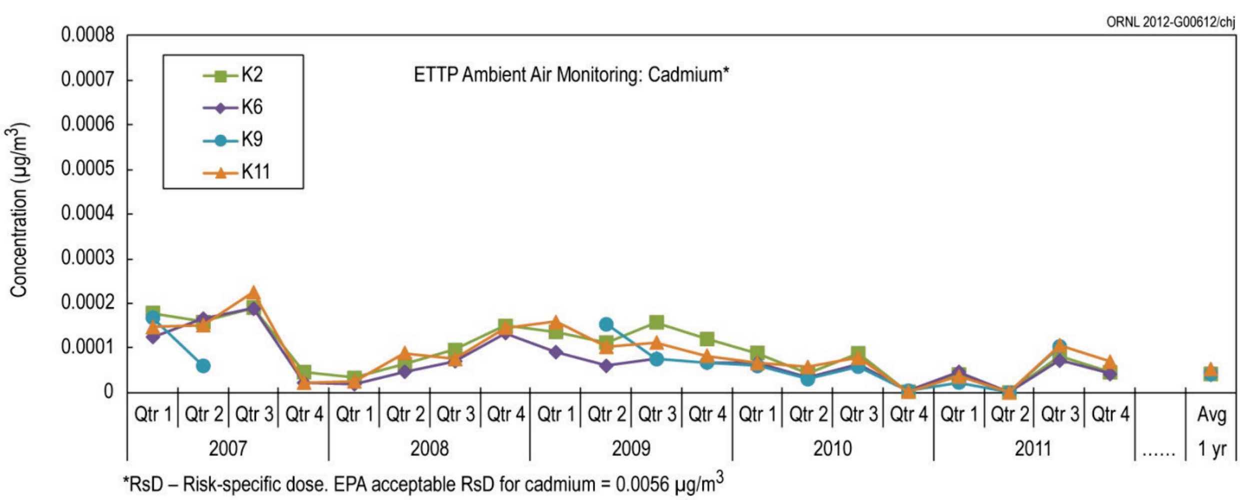


Fig. 3.16c. Cadmium monitoring results: 5-year history through 2011.

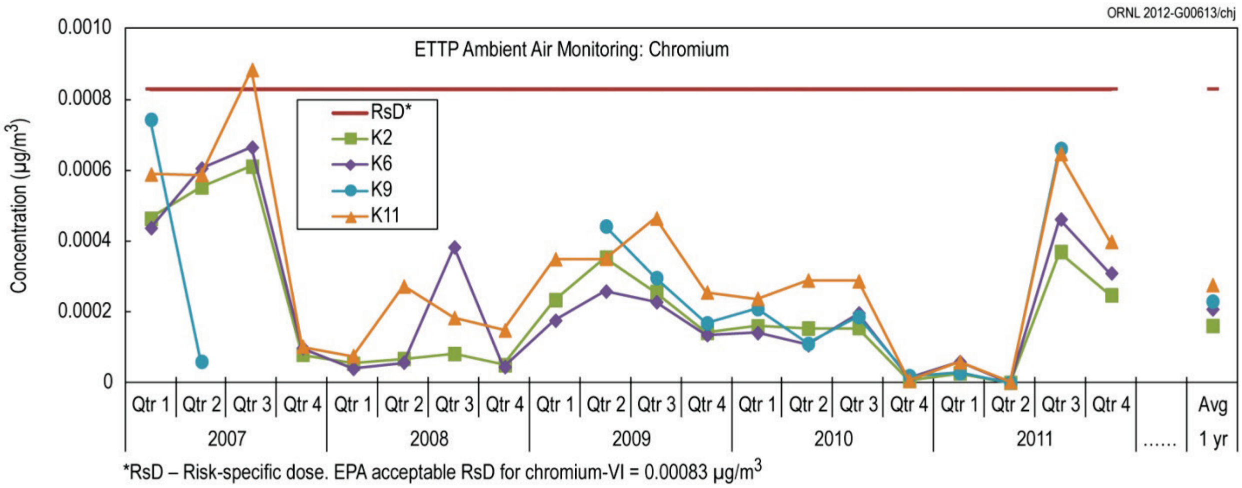


Fig. 3.16d. Chromium monitoring results: 5-year history through 2011.

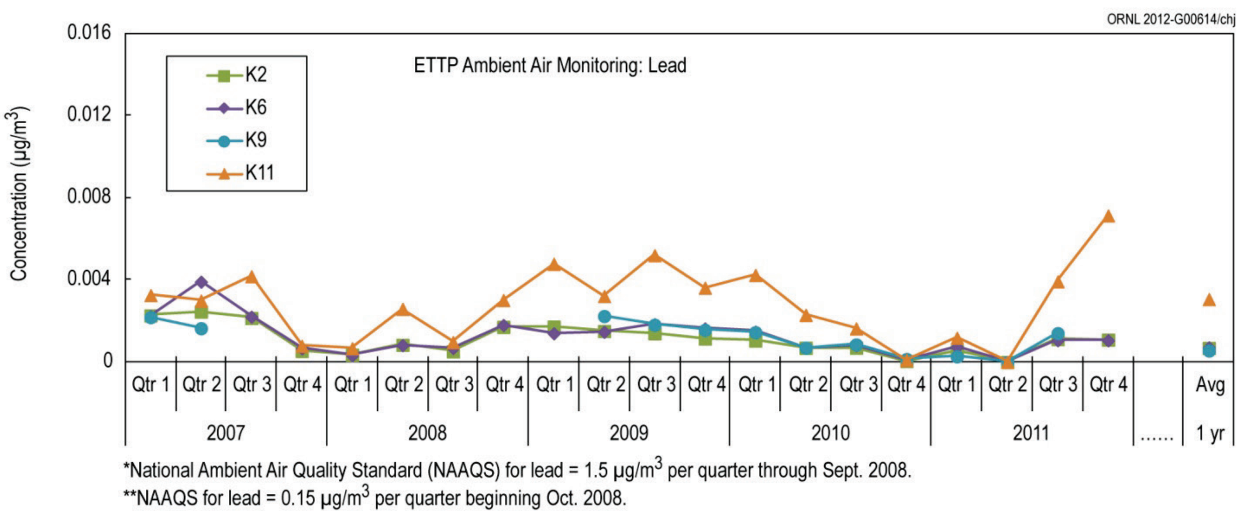
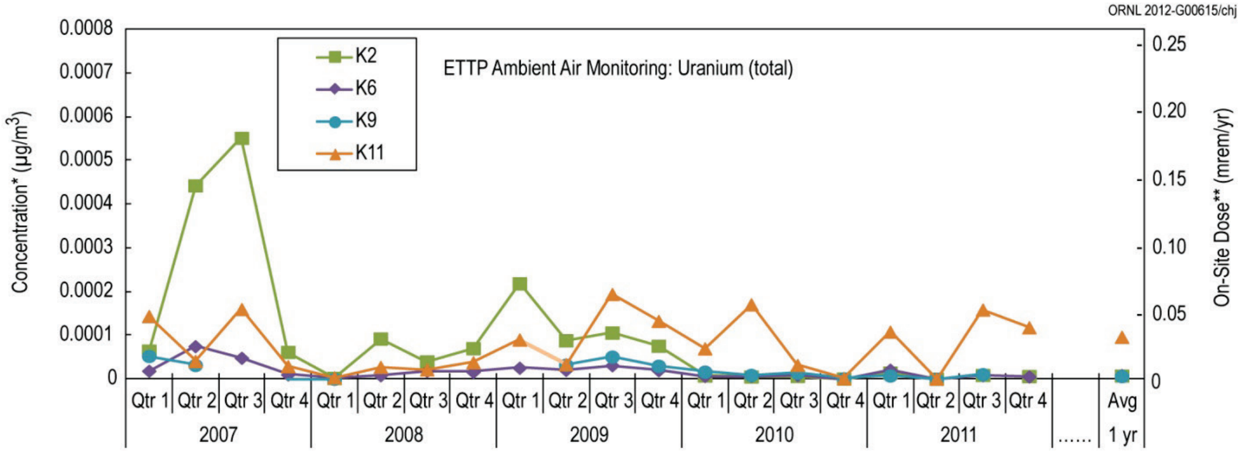


Fig. 3.16e. Lead monitoring results: 5-year history through 2011.

Total uranium was measured as a quarterly composite of continuous weekly samples from stations K2, K6, K9, and K11. The total uranium mass for each sample was determined by ICP-MS. Figure 3.17 illustrates the air concentrations of uranium for the past 5 years based on quarterly composites of weekly continuous samples. The uranium averages and maximum individual concentration measurements for all sites are presented in Table 3.4. The averaged results ranged from 0.000006 $\mu g/m^3$ to 0.000096 $\mu g/m^3$. The highest 12-month average result (0.000096 $\mu g/m^3$) was measured at Station K11. The annual average uranium value for all stations was 0.000029 $\mu g/m^3$. The location of Station K11 is in close proximity to projects that are demolishing the K-25 gaseous diffusion building and remediating the K-1070-B burial ground area.



*DCG for natural uranium resulting in 100 mrem/year is 1.03E-13 µCi/m^3 = 0.15 µg/m^3
**EPA approved ORR on-site business receptor dose assumes a 50% annual occupancy

Fig. 3.17. Uranium monitoring results: 5-year history through 2011.

Table 3.4. Total uranium in ambient air by ICP-MS at East Tennessee Technology Park

Station	No. of Samples	Concentration[a]				Percentage of DCG[b]	
		(µg/m3)		(µCi/mL)		(%)	
		Avg	Max[c]	Avg	Max	Avg	Max
K2	4	0.000007	0.000014	4.84E-18	9.47E-18	<0.01	0.01
K6	4	0.000009	0.000021	5.71E-18	1.39E-17	0.01	0.01
K9	3	0.000006	0.000011	4.01E-18	7.07E-18	<0.01	0.01
K11	4	0.000096	0.000158	6.40E-17	1.06E-16	0.06	0.11
ETTP total	15	0.000029		1.96E-17		0.02	

[a]Mass-to-curie concentration conversions conservatively assume a natural uranium assay of 0.717% 235U.

[b]DOE O 5400.5 DCG for naturally occurring uranium is an annual concentration of 1E-13 µCi/mL, which is equivalent to a 100 mrem annual dose.

[c]Maximum individual sample analysis result with dose calculations conservatively assuming the value to be an annual concentration.

Abbreviations

DCG = derived concentration guide
ETTP = East Tennessee Technology Park
ICP-MS = inductively coupled plasma–mass spectrometer

The ICP-MS results are compared with the derived concentration guide (DCG) for natural uranium as listed in DOE O 5400.5. The DCG is based on an annual air concentration exposure that would give a dose of 100 mrem. The highest annual result (K11) corresponds to 0.06% of the DCG. The single sampling location with the highest quarterly concentration (0.000158 µg/m^3) during 2011 was at station K11. If this concentration were extrapolated to a 12-month exposure, it would only represent 0.11% of the DCG.

Radiochemical analyses were initiated during 2000 on quarterly composite samples collected at all stations. The selected isotopes of interest are ^{237}Np, ^{238}Pu, ^{239}Pu, ^{99}Tc, and isotopic uranium (^{234}U, ^{235}U, and ^{238}U). Table 3.5 presents the concentration and dose results for each of the radionuclides for 2011.

Table 3.5. Radionuclides in ambient air at East Tennessee Technology Park, 2011

Station	Concentration (µCi/mL)							
	^{237}Np	^{238}Pu	^{239}Pu	^{99}Tc	^{234}U	^{235}U	^{238}U	Total
K2	ND	ND	1.77E-18	2.50E-16	2.75E-17	ND	3.98E-18	2.83E-16
K6	ND	ND	9.03E-19	8.22E-17	2.12E-17	ND	2.73E-18	1.07E-16
K9	ND	ND	3.28E-18	5.38E-18	2.65E-17	ND	3.39E-18	3.85E-17
K11	ND	ND	ND	7.52E-16	2.92E-16	2.20E-17	5.89E-17	1.12E-15
Station	**40 CFR 61, Effective Dose (mrem/year)**							
	^{237}Np	^{238}Pu	^{239}Pu	^{99}Tc	^{234}U	^{235}U	^{238}U	Total
K2	ND	ND	0.0038	0.0066	0.0127	ND	0.0023	0.0254
K6	ND	ND	0.0019	<0.0001	0.0105	ND	0.0017	0.0142
K9	ND	ND	0.0052	<0.0001	0.0118	ND	0.0017	0.0188
K11	ND	ND	ND	0.0002	0.1239	0.0080	0.0213	0.1534

EPA requires facilities to use approved computer models to determine ED. The potential for public exposure to radionuclide emissions as measured at all ETTP area ambient air stations is assessed using the EPA's CAP88-PC (Version 3) model. Figure 3.18 is a 5-year historical summary chart of CAP88-based dose-calculation results of ETTP ambient air isotopic radionuclide analyses. Each quarterly result is the total dose from all measured radionuclides during the applicable measurement period. The 12-month rolling dose total is the summation of the previous four quarterly results. All data show potential doses well below the 10 mrem annual dose limit.

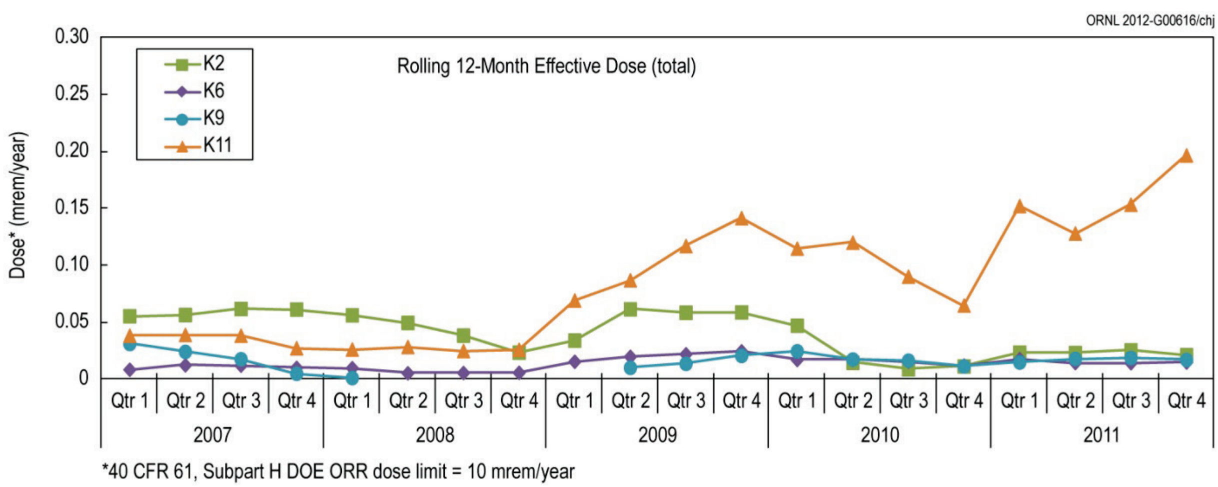


Fig. 3.18. Radionuclide monitoring results: 5-year rolling, 12-month dose history through 2011.

3.5 Water Quality Program

3.5.1 NPDES Permit Description—New NPDES Permit

Currently there are 108 NPDES-permitted storm water outfalls at ETTP. As part of the current NPDES permit, these storm water outfalls are listed in two groups based on the types of flows being discharged through the outfalls. A total of 32 storm water outfalls are sampled as being representative of these groups.

3.5.2 ETTP Storm Water Pollution Prevention Program

The current ETTP NPDES permit includes a requirement to review and update, if necessary, the Storm Water Pollution Prevention Program (SWP3) plan, at least annually. This requirement is met by publishing the ETTP SWP3 Annual Update Report, which includes SWP3 monitoring results, site inspection summaries, and other information from the fiscal year that is ending. Additionally, the SWP3 Baseline Document serves as a reference document for implementing and conducting the required elements of the ETTP SWP3. This document will continue to be used as part of the ETTP SWP3 specified in the current ETTP NPDES permit. The baseline document is reviewed annually and updated as necessary.

3.5.2.1 Monitoring Storm Water Runoff from K-25 D&D Activities

D&D of the K-25 Building is ongoing and will continue through at least FY 2012. The demolition of the west wing of the building was completed in FY 2010. Initial demolition activities for the east wing of the K-25 Building began in July 2011. To closely monitor the storm water runoff from the building demolition activities on the east side of the K-25 building, sampling will be performed at regular intervals during the demolition process. Initial sampling has been performed to provide baseline data for conditions present before demolition begins. Additional monitoring will be performed at about 3 months and 6 months after demolition begins. If necessary, modifications to storm water controls will be made based on the results of this sampling effort.

Sampling was performed at storm water Outfall 210 to provide information on the baseline conditions present at the northern portion of the east wing of the K-25 Building. In addition, sampling was performed at manhole 18102, which receives storm water runoff from the southern portion of the east wing of the K-25 Building, to provide information on the baseline conditions present at the southern portion of the east wing of the K-25 Building. The flow that travels through this manhole eventually discharges through storm water Outfall 490. Outfall 490 was later sampled as a replacement for manhole 18102 (Tables 3.6 and 3.8).

Table 3.6 contains information on the locations and parameters to be sampled as part of this effort. Table 3.7 contains information on parameters that exceeded screening levels. Table 3.8 contains analytical data from samples that were collected several months after the initiation of the demolition activities at the east wing of the K-25 Building.

Table 3.6. Monitoring performed as part of the K-25 Building decontamination and decommissioning

RA or D&D activity	Sampling location	Sampling frequency	Gross alpha/beta	U Isotopic, ^{99}Tc	PCBs	VOCs	Metals/ Mercury
East Wing of K-25 Building	Outfall 210	Before demolition of east wing and at 3 months and 6 months (approximately) after initiation of demolition	X	X	X		X
	Manhole 18102/ Outfall 490	Before demolition of east wing and at 3 months and 6 months after initiation of demolition	X	X	X	X	X

Abbreviations
D&D = decontamination and decommissioning
PCB = polychlorinated biphenyl
RA = remedial action
VOC = volatile organic compound

Table 3.7. Analytical results over screening levels for K-25 Building decontamination and decommissioning monitoring before demolition

Sampling location	Copper (µg/L)	Lead (µg/L)	Mercury (µg/L)	Zinc (µg/L)
SCREENING LEVEL	**7**	**2.5**	**Detectable**	**75**
210	15.9	5.84	0.00553	—
Manhole 18102	21.2	8.64	0.020	458

Table 3.8. Analytical results over screening levels for K-25 Building decontamination and decommissioning monitoring after initiation of demolition activities

Sampling location	Date Sampled	Copper (µg/L)	Lead (µg/)	PCB-1254 (µg/L)	PCB-1260 (µg/L)	Zinc (µg/L)	Mercury (µg/L)
	Screening level	**7**	**2.5**	**Detectable**	**Detectable**	**75**	**Detectable**
210	12/6/11	13.3	171	0.37	0.36	105	0.0609
490	12/6/11	—	3.43	—	—	—	—

Abbreviations
PCB = polychlorinated biphenyl

All samples collected as part of this SWP3 sampling effort were manual grab samples. Manual grab samples were collected according to the guidelines specified in Sections 3.1.2 and 3.3.1 of the EPA's *NPDES Storm Water Sampling Guidance Document* (EPA 1992) and applicable procedures that have been developed by the sampling subcontractor.

3.5.2.2 Sampling for 2013 NPDES Permit Renewal Application

A new NPDES permit will be issued for ETTP in 2013. The permit application for this permit renewal is required to be submitted to TDEC by June 2013 to allow TDEC 180 days to review it. About 2 years remain to collect all of the analytical data that are required to complete the EPA 2E and 2F forms that are required to be submitted in the next NPDES permit renewal application. For all of the required monitoring to be conducted in time for the permit application to be prepared and submitted, about 8 to 10 outfalls must be sampled each year.

Data collected from sampling conducted as part of the SWP3 sampling and analysis plan (SAP) will be used in the completion of EPA 2E or 2F forms, as applicable.

The sample collection method for each parameter is specified by the analytical method for that parameter. Parameters that are designated to be collected as composite samples were collected by use of ISCO samplers or by manual grab if they could not be collected by ISCO sampler due to location, volume, or time constraints. No parameters designated in Table 3.9 to be collected by manual grab only were collected by ISCO compositor under any circumstances; however, other parameters that are designated as grab samples may have been collected either manually or with ISCO samplers.

Table 3.9. Status of NPDES permit renewal sampling

Storm water outfall	**Manual Grab Only** (VOCs, SVOCs, TOC, O&G, acetone, acetonitrile, MEK)	**Manual Grab or Grab by-Compositor** (TKN, phenol, total phosphorus, nitrate/nitrite, cyanide)	**Composite-by-Compositor** (Hg, PCBs, TSS, pest/herb, anions, BOD, COD, metals, gross alpha/beta, isotopic U, total U, ^{99}Tc, sulfide	**Field Readings** (pH, temperature, TRC)
	Date Sampled	**Date Sampled**	**Date Sampled**	**Date Sampled**
05A	4/20/2010	4/20/2010	6/10/2010	2/22/2012
100	11/23/2010			11/23/2010
142	5/3/2011*	9/26/2011*	9/16/2010	5/3/2011*
150	4/27/2011*	4/27/2011*	4/20/2011*	4/27/2011*
170	11/15/2010	11/16/2010	11/4/2010	11/15/2010
180	4/20/2010	6/29/2010	6/10/2010	11/21/2011*
190	9/22/2010	11/4/2010*	9/22/2010	9/22/2010
195	11/23/2010	10/19/2011*	10/30/2011*	11/23/2010
198	9/26/2011*	10/11/2011*	9/26/2011*	9/26/2011*
230	9/22/2010	9/22/2010	8/12/2010	9/22/2010
250	4/27/2011*	2/24/2011 and 4/5/2011*	2/2/2011*	4/27/2011*
280	4/27/2011*	4/5/2011*	2/24/2011*	4/27/2011*
294	9/26/2011*	2/24/2011*	2/2/2011*	9/26/2011*
334				
340	**	**	**	**
350		11/4/2010	10/25/2010	
380	1/18/2011*	3/12/2010	2/10/2010	1/18/2011*
382	3/25/2010	3/25/2010	3/12/2010	
410	3/11/2010	3/12/2010	2/22/2010	11/3/2011*
430	2/9/2010	3/12/2010	3/3/2010	10/11/2011*
490	10/11/2011*			10/11/2011*
510	11/3/2011*	11/28/2011*	11/15/2011 and 11/21/2011*	11/3/2011*
560				
660		4/28/2011*	4/12/2011*	
690	1/18/2011*	2/2/2011*	1/19/2011*	1/18/2011*
694	5/3/2011*	2/24/2011*	11/30/2010	1/18/2011*
700	4/27/2011*	8/12/2010	8/5/2010	4/27/2011*
710	2/9/2010	12/13/2009	12/19/2009	11/3/2011*
724	3/25/2010	3/25/2010	3/12/2010	2/16/2012
890	2/16/2012	2/16/2012	2/16/2012	2/16/2012
930	11/21/2011*	11/21/2011*	11/15/2011*	11/21/2011*
992	3/11/2010	3/25/2010	3/12/2010	

*Samples were collected as part of the 2011 Storm Water Pollution Prevention Program sampling effort.
**Does not flow.

Abbreviations

BOD = biological oxygen demand
COD = chemical oxygen demand
MEK = methyl ethyl ketone
O&G = oil and gas
PCB = polychlorinated biphenyl
SVOC = semivolatile organic compound

TKN = total Kjeldahl nitrogen
TOC = total organic carbon
TRC = total residual chlorine
TSS = total suspended solids
VOC = volatile organic compound

All samples were collected from discharges resulting from storm events producing greater than 0.1 in. of rainfall within a time period of 24 h or less and which occurred at least 72 h after any previous rainfall greater than 0.1 in. in 24 h. Some variance in the 72 h time frame was allowed due to unforeseeable circumstances such as weather conditions and sampling equipment problems.

Table 3.10 contains nonradiological results from this portion of the 2011 SWP3 sampling effort that exceeded screening levels. Table 3.11 contains the radiological results from this effort that exceeded screening levels. Table 3.12 provides the isotopic totals of the major isotopes that were detected in storm water discharges in 2011. Although the listed isotopes exceeded the screening criteria, the values are within the range of historic results.

Table 3.10. Screening level exceedances from NPDES permit application sampling—nonradiological

	Copper (µg/L)	Lead (µg/L)	Mercury (µg/L)	Zinc (µg/L)	Chromium (µg/L)	Cadmium (µg/L)	Arsenic (µg/L)	Thallium (µg/L)	PCB-1242 (µg/L)	PCB-1254 (µg/L)	PCB-1260 (µg/L)
SCREENING LEVEL	**7**	**2.5**	**detectable**	**75**	**8**	**Detectable**	**7**	**detectable**	**detectable**	**detectable**	**detectable**
Storm water Outfall 142	—	—	—	58.2	—	—	—	—	—	—	—
Storm water Outfall 150	21.4	—	—	—	—	—	—	—	0.091	0.091	—
Storm water Outfall 195	—	—	0.102	—	—	—	—	—	—	—	—
Storm water Outfall 198	—	7.96	—	—	—	1.01	—	—	—	—	—
Storm water Outfall 250	—	—	0.379	—	—	—	15.2	7.92	—	—	—
Storm water Outfall 280	25.7	9.61	0.077	89.2	—	1.9	8.27	—	—	3.2	1
Storm water Outfall 294	—	—	—	—	—	—	34.1	14	—	—	—
Storm water Outfall 660	7.17	—	—	—	13.3	—	—	—	—	—	—
Storm water Outfall 690	8.02	—	—	—	—	—	23.1	5.47	—	—	—

Abbreviations
NPDES = National Pollutant Discharge Elimination System
PCB = polychlorinated biphenyl

Table 3.11. Screening level exceedances from NPDES permit application sampling—radiological

	Total Uranium (µg/L)	Gross Alpha (pCi/L)	U 233/234 (pCi/L)	U-238 (pCi/L)
SCREENING LEVEL	**31**	**15**	**20**	**24**
Storm water Outfall 294	49.3	30.7	23.1	—

Abbreviations
NPDES = National Pollutant Discharge Elimination System

Table 3.12. Radionuclides released to off-site surface waters from the East Tennessee Technology Park storm water system, 2011 (Ci)[a]

Radionuclide	Amount
^{99}Tc	3.0E–2
^{234}U	8.0E–3
^{235}U	5.0E–4
^{238}U	4.9E–3

[a] 1 Ci = 3.7×10^{10} Bq.

3.5.2.3 Storm Water Outfall 992 Investigation

A total of 5.97 million tons of coal were burned at the K-701 Powerhouse during its operation from 1944–1962. Bottom ash, coal fines, slag, and other by-products of coal combustion were buried at the K-720 coal ash pile. The K-720 coal ash pile is about 9 acres in size. In the mid-1990s, the coal ash pile was spread out, covered with soil, limed, and seeded.

Runoff and leachate from the K-720 coal ash pile have resulted in occasional low pH readings at storm water Outfall 992 for several years. A number of violations of the ETTP NPDES permit have occurred as a result of the low pH of the discharge from storm water Outfall 992. In addition, elevated levels of metals that are often found in coal, including arsenic, selenium, etc. have been detected in storm water samples from the area.

In September 2010, several locations in the storm water Outfall 992 watershed were designated for periodic pH monitoring in an attempt to identify the sources of the low pH discharges to the outfall. Initially, five locations were chosen for monitoring. These five locations were monitored during varying weather conditions beginning in September 2010. Figure 3.19 shows the location of these five sampling points in relation to Outfall 992. In January 2011, an additional 5 locations were added, and a total of 10 locations were designated to be monitored on a periodic basis for pH. Figure 3.20 indicates the location of these 10 monitoring locations in the storm water Outfall 992 area.

Table 3.13 contains information from the pH monitoring that was conducted in this area during 2010 and 2011. Several of the pH readings within the storm water Outfall 992 watershed were below the NPDES permit limit of 6.0 standard units. As these readings were not taken at the NPDES-permitted outfall location at storm water Outfall 992, however, they are not permit violations.

ORNL 2012-G00369/chj

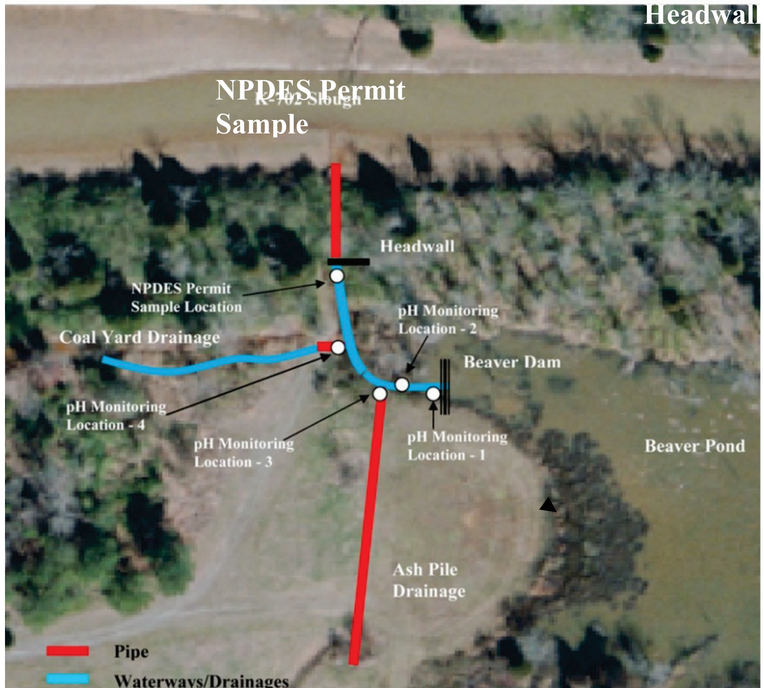


Fig. 3.19. Initial monitoring locations for the storm water Outfall 992 subwatershed.

ORNL 2012-G00370/chj

Fig. 3.20. Sampling locations for the storm water Outfall 992 drainage network.

Table 3.13. Monitoring of pH in the storm water Outfall 992 drainage area

Locations	Seep immediately below beaver dam (992-1)	Discharge channel above mixing zone of other flows (992-2)	Discharge from pipe carrying ash pile drainage (992-3)	Discharge from pipe carrying coal pile drainage (992-4)	Immediately before beaver dam in beaver pond (992-5)	Drainage network of 992-3 upstream of pipe openings (992-6)	Small ponded area near access road in upper reach of beaver pond (992-7)	Drainage network of 992-4 near well #UNW-073 (992-8)	Sluice pond upstream of 992-4 (992-9)	Drainage channel immediately above 992-4 (992-10)	Weather Conditions - Day of Monitoring
Parameters	pH	pH	pH	pH	pH	pH	pH	pH	pH	pH	wet/dry
9/9/10	5.1	5.9	7.3	no flow	7.1						dry
9/13/10	5.9	5.8	6.4	no flow	6.9						dry
9/14/10	5.9	5.7	6.2	no flow	6.7						dry
9/15/10	5.9	6.2	6.6	no flow	7.0						dry
9/16/10	5.9	5.9	6.3	no flow	6.9						dry
9/21/10	5.8	6.0	6.4	no flow	6.7						dry
9/27/10	6.0	6.1	6.4	no flow	6.9						wet
9/30/10	5.7	5.9	6.3	no flow	6.7						dry
10/5/10	5.9	6.0	6.5	no flow	6.8						dry
10/7/10	5.7	5.8	6.4	no flow	6.7						dry
10/14/10	5.8	6.1	6.5	no flow	7.0						wet
10/25/10	5.3	5.6	6.2	no flow	6.9						wet
11/4/10	6.3	6.3	6.8	5.7	7.2						wet
11/15/10	5.9	6.3	6.6	no flow	6.7						wet
11/16/10	5.7	5.9	5.8	4.6	6.6						wet
11/16/10	6.2	6.1	6.5	4.2	7.2						wet
11/17/10	6.2	6.1	5.8	4.8	6.7						wet
11/18/10	6.3	5.9	6.1	5	7.0						dry
12/1/10	6.9	6.9	7.2	6.2	7.1						wet
1/24/11	6.3	5.9	6.1	4.5	6.8	6.7	6.6	6.5	6.7	3.9	dry
1/31/11	6.5	6.2	6.8	4.3	7.1	7.1	6.9	6.5	6.9	3.8	dry
2/1/11	6.3	6.3	6.7	4.2	7.0						dry
2/2/11	6.6	6.2	6.0	4.4	6.9						wet
2/22/11	6.5	6.2	6.1	4.6	7.0	6.9	7.0	6.0	6.6	4.7	wet
2/25/11	6.9	6.7	6.3	4.3	7.1						wet
4/11/11	6.2	6.1	6.4	5.5	7.7	6.6	6.4	6.4	6.6	6.7	dry

*Highlighted measurements are to or less than the lower pH limit of 6.0 standard units

The pH readings shown in Table 3.13 indicate that the primary concern with pH at storm water Outfall 992 is the channel that receives drainage from the coal ash sluice pond. This channel also receives drainage from a portion of the coal ash pond that was not completely covered with soil during the remedial actions that were conducted in the mid-1990s. The discharge point for this channel is designated as sampling location 992-4 in Table 3.13.

A pH profile of the ash sluice channel was performed in April 2011. The pH of the water discharged through this channel is often very low, and it may adversely affect the pH of the entire discharge from storm water Outfall 992. A profile was conducted along the length of the channel to determine where coal ash pile runoff with a low pH may be seeping into the channel. Field readings for pH and conductivity were collected every 50 ft from location 992-4 to 992-8 (see Fig. 3.21) in an effort to determine the location of any groundwater seeps or other sources of flow into the channel that might reduce the pH of the channel flow. The pH and conductivity results from this survey are shown on Table 3.14.

ORNL 2012-G00617/chj

Fig. 3.21. pH and conductivity profile for coal ash sluice channel—April 2011.

Table 3.14. Comparison of April 2011 and September 2011 field data from ash sluice channel

Monitoring Location	pH—April 2011	pH—September 2011	Conductivity—April 2011	Conductivity—September 2011
10	5.7	6.2	588	681
10+25	5.9	6.2	598	746
10+50	6.0	4.6	614	778
10+75	5.7	6.4	648	837
10+100	6.1	6.4	619	848
10+125	6.2	6.5	616	847

Table 3.14. (continued)

Monitoring Location	pH—April 2011	pH—September 2011	Conductivity—April 2011	Conductivity—September 2011
10+150	6.1	6.5	624	864
10+175	6	6.6	637	853
10+200	5.6	6.5	629	793
10+225	6.2	6.6	573	764

From the information gathered in this survey, areas were identified where remedial actions were needed. There were several areas along the coal ash sluice channel where the ash had not been adequately covered with soil when the original remediation of the area was performed. Ash had also been pushed into the coal ash sluice channel and was in direct contact with the runoff flowing through the channel. Figures 3.22 and 3.23 show examples of locations in the coal ash pile area adjacent to the ash sluice channel where ash had not been properly covered.

ORNL 2012-G00363/chj

Fig. 3.22. Exposed ash near ash sluice channel.

ORNL 2012-G00364/chj

Fig. 3.23. Another area near ash sluice channel where ash had not been properly covered with soil.

The following corrective actions were implemented to address these concerns:

- exposed ash was pulled back from the edge of the drainage channel with a backhoe and was spread onto the flat area immediately adjacent to the sluice channel;
- rip-rap was placed along the bank of the coal ash sluice channel to cover the area where the ash was exposed;
- the flat area of the coal ash pile located adjacent to the coal ash sluice channel was covered with clay to limit storm water infiltration into the ash;
- topsoil was placed over the area that was covered with clay; and
- the area adjacent to the coal ash sluice channel was treated with agricultural lime, seeded, and covered with straw.

Figures 3.24–3.27 show the remedial work that was performed in the coal ash pile area and the ash sluice channel.

ORNL 2012-G00618/chj

Fig. 3.24. Initial installation of rip-rap along bank of ash sluice channel.

ORNL 2012-G00619/chj

Fig. 3.25. Placement of clay layer over exposed coal ash.

ORNL 2012-G00620/chj

Fig. 3.26. Ash pile area after remedial actions were completed.

ORNL 2012-G00621/chj

Fig. 3.27. Completed placement of rip-rap along bank of ash sluice channel.

A second pH and conductivity profile was conducted in September 2011 in an effort to determine what effect the remedial work at the coal ash area and the ash sluice channel may have had on the pH of the flow in the ash sluice channel. Field readings for pH and conductivity were collected in the locations indicated in Fig. 3.28 using the same method that was used in the profile performed in April 2011. The profile was performed about 12 h after a rainfall event of 0.3 in. and about 1 week after a rainfall event of more than 7 in. Table 3.14 shows the data from this profile in comparison to the data collected during the April 2011 profile.

ORNL 2012-G00622/chj

Fig. 3.28. pH and conductivity profile for coal ash sluice channel—September 2011.

From the information in Table 3.14 it appears as if the remedial actions may have been successful in raising the pH of the flow in the ash sluice channel. All of the pH readings except for one were between 6.2 and 6.6 standard units, whereas the pH readings collected in April 2011 ranged from 5.6 to 6.4 standard units. The conductivity readings for the water in the channel were somewhat elevated over the conductivity readings collected in the April 2011 profile, but they were not elevated enough to be of concern. The water in the ash sluice channel appeared to be clearer and contain less discoloration than had been observed before the corrective actions were undertaken.

A single pH reading collected at location 10+50 was anomalous. A reading of 4.6 standard units was collected at this location. The pH instrument was checked against a standard to make sure the reading was accurate. This sampling point is located at the extreme western end of the newly installed rip-rap channel. It is possible that a seep with a low pH may have been redirected toward this location by the remedial actions conducted at the ash pile area and the ash sluice channel. Additional monitoring of the ash sluice channel will be conducted in the future to determine the additional impacts of the corrective actions and to determine whether additional corrective actions may be required.

In addition to monitoring field parameters at these watershed locations, metals samples were collected in February and April 2011. Several metals were identified at levels over screening criteria as part of these sampling efforts. Table 3.15 contains information on the metals that exceeded screening criteria.

Table 3.15. Screening criteria exceedances in storm water Outfall 992 watershed flows

Location Number	Monitoring Parameters	Screening Levels	Analytical Results—February 2011	Analytical Results—April 2011
992-1	Arsenic	7	8.34	16
992-2	Arsenic	7	—	13.9
	Selenium	5	10.7	10.9
992-3	—	—	—	—

Table 3.15. (continued)

Location Number	Monitoring Parameters	Screening Levels	Analytical Results—February 2011	Analytical Results—April 2011
992-4	Selenium	5	9.15	11.6
	Silver	2.4	—	2.83
	Nickel	39	39	—
992-5	—	—	—	—
992-6	Selenium	5	—	6.56
992-7	Selenium	5	—	11.3
992-8	Arsenic	7	—	16
	Selenium	5	—	5.7
	Silver	2.4	—	3.53
992-9	Silver	2.4	—	2.9
992-10	Selenium	5	—	7.11
	Silver	2.4	—	2.41

Investigation of the K-720 coal ash pile is ongoing. These monitoring activities are being conducted as part of the Zone 1 remedial action process under CERCLA.

3.5.2.4 pH and Chromium Issues at the K-33 Demolition Area

Building K-33 was more than 1.4 million ft^2 of concrete and steel. The facility was constructed in 1954 as a uranium enrichment facility and operated from 1954 to 1985. As part of a reindustrialization effort in 1997, the majority of the D&D had been performed. Afterward, however, the remaining facility still contained radiological and chemical contamination, hazardous waste, asbestos and PCB contamination. In April 2010, DOE awarded the contract for the demolition and disposition of Building K-33 to LATA-Sharp Remediation Services. Demolition of the building and disposition of the waste materials generated during the demolition activities are expected to be complete in spring 2012.

Demolition and disposition activities at Building K-33 included

- siding removal,
- building demolition to the slab, and
- packaging and transportation of all associated wastes to on-site waste disposal facilities operated by DOE.

After the K-33 building was brought down, the debris was segregated and consolidated into piles of concrete and steel across the remaining pad. The process of bringing down the building, tracking across debris with heavy equipment, and stockpiling the concrete caused it to become pulverized. A large portion of the building debris generated by the demolition of K-33 was disposed at EMWMF, where elevated levels of hexavalent chromium were detected in contact water from the disposal cell. An investigation revealed that the creation and liberation of hexavalent chromium from this concrete was the result of the following factors.

- The increased surface area of the concrete from being pulverized into smaller pieces.
- The chemical make-up of concrete, which causes the pH of rain water to increase upon contact. Elevated pH aids in the release of hexavalent chromium from concrete and also the transformation of chromium to hexavalent chromium.
- The amount of concrete exposed coupled with total chromium and hexavalent chromium available in the concrete.
- The amount/frequency of rainfall.

Periodic sampling was initiated in the fall of 2010 and continued into the winter of 2011 to measure discharges from storm water outfalls potentially impacted by the K-33 demolition project activities.

The results of this sampling did not indicate the presence of elevated levels of chromium until the sampling event of April 5, 2011. Samples were taken on April 5, 2011 from the three primary storm water outfalls (storm water Outfalls 690, 700, and 710) that receive surface water from the K-33 site. Hexavalent chromium levels in the outfalls were measured at 474 µg/L, 357 µg/L, and 310 µg/L, respectively. For reference, the screening level for hexavalent chromium is 8 µg/L.

As part of an agreement between DOE, TDEC, and EPA CERCLA regulators, hexavalent chromium and total chromium samples are collected twice per month from storm water Outfalls 690, 700, and 710; an instream location downstream of Outfall 690; the K-901-A pond weir; and the K-1250-4 bridge (see Fig. 3.29). This effort is rainfall dependent, as some of these locations cannot be sampled during extremely dry periods. This monitoring will provide information not only on the levels of hexavalent and total chromium in discharges from the K-33 pad, but also on how these discharges may be affecting the levels of hexavalent and total chromium in the receiving waters. This sampling effort was initiated on April 5, 2011, and will be conducted until all remedial activities at the K-33 area have been completed. Hexavalent and total chromium data collected since April 5, 2011, are presented in Table 3.16. As noted in the table, the results beginning in late June of 2011 were significantly lower than the earlier results in April and May of 2011. This was a result of significant concrete waste removal from the D&D action, less significant rain events during the drier periods of the year, and implementation of additional storm water controls.

In September 2011, TDEC granted permission to discontinue sampling at the instream location downstream of Outfall 690 because all analytical results for total chromium and hexavalent chromium at that location were below detection levels. In addition, TDEC granted permission to reduce the sampling frequency for the remaining locations from twice per month to once per month.

On April 12, 2011, sampling subcontractor personnel were collecting routine NPDES permit compliance data at storm water Outfall 690. They obtained a pH reading of 9.6 standard units at the designated NPDES monitoring location for that outfall. The pH reading of 9.6 standard units is outside the NPDES permitted range of 6.0–9.0 standard units for this outfall. This constitutes a noncompliance with the ETTP NPDES storm water permit. An investigation revealed that the fresh concrete rubble from the demolition effort was reacting with rainfall and dust suppression runoff to raise the pH.

To provide more effective control of elevated pH levels and hexavalent chromium in the storm water runoff from the K-33 building pad, TDEC agreed to allow the installation of small water conditioning units in the three primary catch basins that collect storm water from the area. The automated conditioning systems use probes to detect conditions that would support hexavalent chromium mobilization as well as measuring the pH of the storm water. Sodium bisulfite is used as a reducing agent for the hexavalent chromium and assists in lowering pH. Sulfuric acid is used when more substantive pH adjustment is required. These systems have also been placed upstream from three storm water outfalls where compliance samples are taken. Should the system detect conditions conducive for hexavalent chromium mobilization or an elevated pH level, then chemicals are immediately metered into the storm water inlet for treatment before the storm water can reach the outfalls The addition of sulfuric acid is also expected to provide some measure of moderation of the elevated pH levels in the storm water runoff from the building pad. Figure 3.30 shows a typical layout for the conditioning units used at the storm water catch basins.

Conditioning units were installed at the following locations:

- catch basin 1027, which is located near the northeast corner of the K-33 pad and drains to storm water Outfall 690;
- catch basin1B002, which is located near the northwest corner of the K-33 pad and drains to storm water Outfall 700; and
- catch basin 6008, which is located near the southwest corner of the K-33 pad and drains to storm water Outfall 710.

Figure 3.31 indicates the locations of the conditioning units relative to the K-33 building footprint. These conditioning units will remain in operation until project completion.

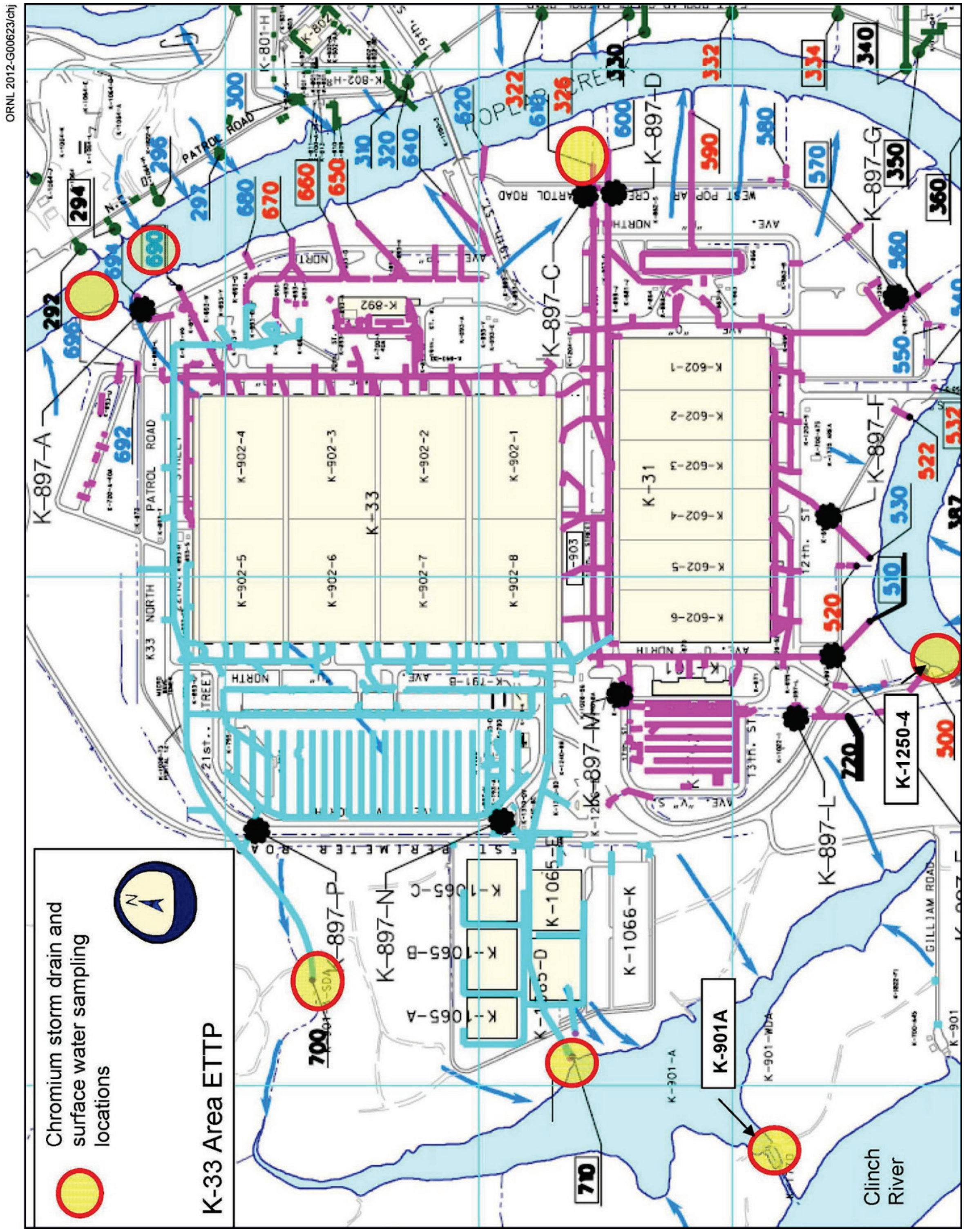


Fig. 3.29. Total chromium and hexavalent chromium sampling locations near building K-33.

Table 3.16. Hexavalent and total chromium results from K-33 storm water outfalls and receiving waters

Poplar Creek Locations	4-5-11 Hex Chrome (µg/L)	4-5-11 Total Chrome (µg/L)	4-12-11 Hex Chrome (µg/L)	4-12-11 Total Chrome (µg/L)	4-28-11 Hex Chrome (µg/L)	4-28-11 Total Chrome (µg/L)	6-16-11 Hex Chrome (µg/L)	6-16-11 Total Chrome (µg/L)	6-22-11 Hex Chrome (µg/L)	6-22-11 Total Chrome (µg/L)	8-4-11 Hex Chrome (µg/L)	8-4-11 Total Chrome (µg/L)	9-5-11 Hex Chrome (µg/L)	9-5-11 Total Chrome (µg/L)	10-19-11 Hex Chrome (µg/L)	10-19-11 Total Chrome (µg/L)	11-15-11 Hex Chrome (µg/L)	11-15-11 Total Chrome (µg/L)	12-6-11 Hex Chrome (µg/L)	12-6-11 Total Chrome (µg/L)
SD-690	474	486	400	436	337	356	68	91.5	6 U	12.6	12	32.2	6 U	6.85	7	9.23	<6	9.45	<6	7.09
Downstream from SD-690	6 U	2 U	6 U	2 U	—	—	6 U	1 U	6 U	2 U	6 U	2 U	6 U	—	—	—	—	—	—	—
Downstream From all Storm water outfalls Poplar Creek (bridge K-1250-4)	—	—	6 U	2 U	6 U	5.36	6 U	1 U	6 U	2 U	6 U	2 U	6 U	2 U	<6	2	<6	1.11	<6	2.85
SD-700	357	361	294	348	436	462	78	89	6 U	6.95 J	—	—	6 U	6.47 J	6	9.29	16	19.5	<6	5.36
SD-710	310	323	263	332	314	354	144	165	6 U	2.16 J	23	35.2	6 U	4.38 J	<6	8.15	10	12.7	<6	5.29
K-901-A Pond	—	—	6 U	17.3	24	38.8	6 U	3.6 J	6 U	2 U	6 U	7.98 J	6 U	3.79 J	<6	2.45	<6	1.18	<6	<2
Rainfall events, inches	1.92	1.92	1.63	1.63	2.42	2.42	1.51	1.51	0.16	0.16	0.63	0.63	6.82	6.82	1.74	1.74	1.08	1.08	1.03	1.03

U—indicates a nondetection at the analytical detection limit,
J—indicates estimated value,
SD—storm water outfall

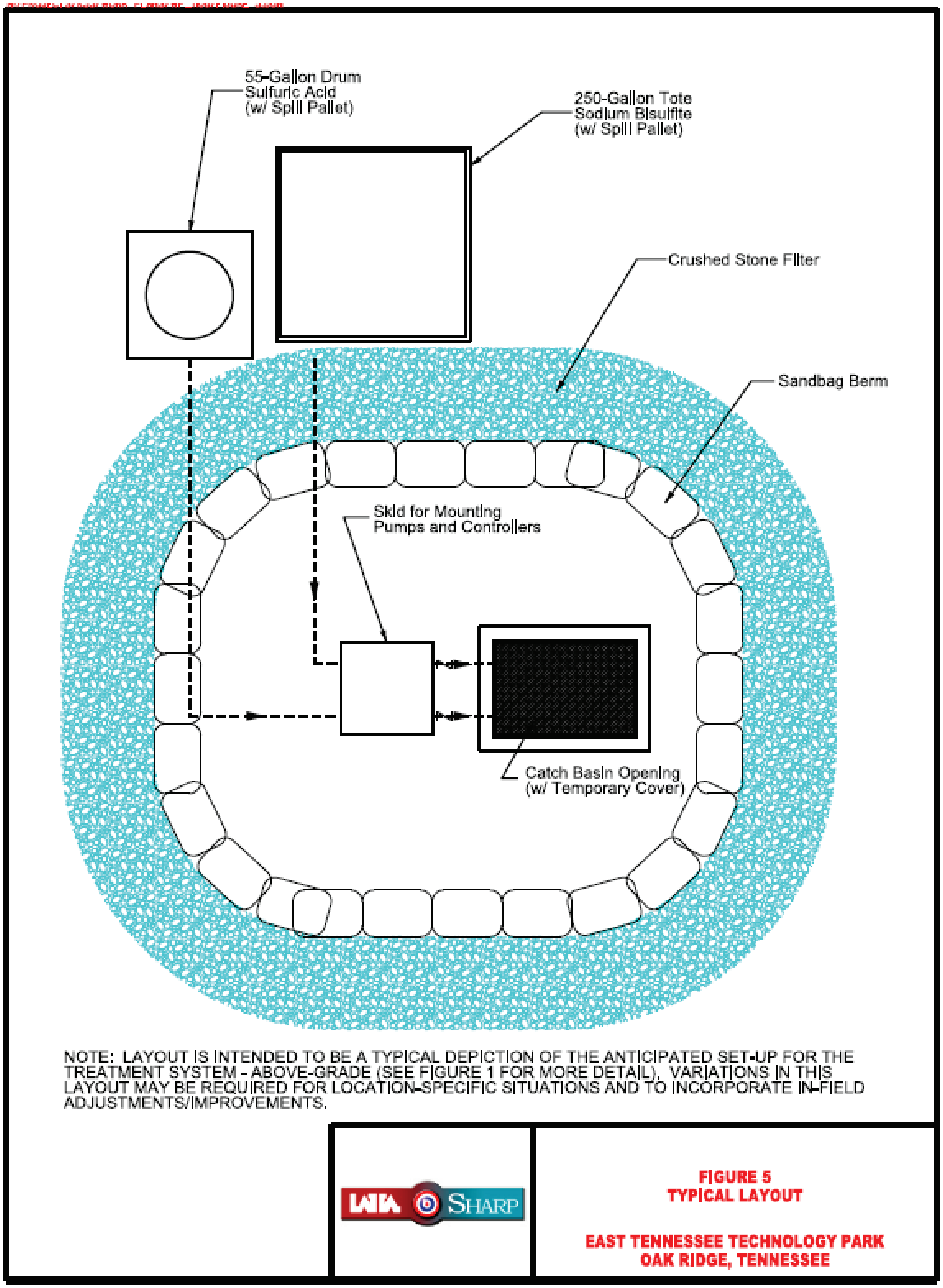


Fig. 3.30. Drawing of storm water conditioning unit used at K-33 storm water catch basins.

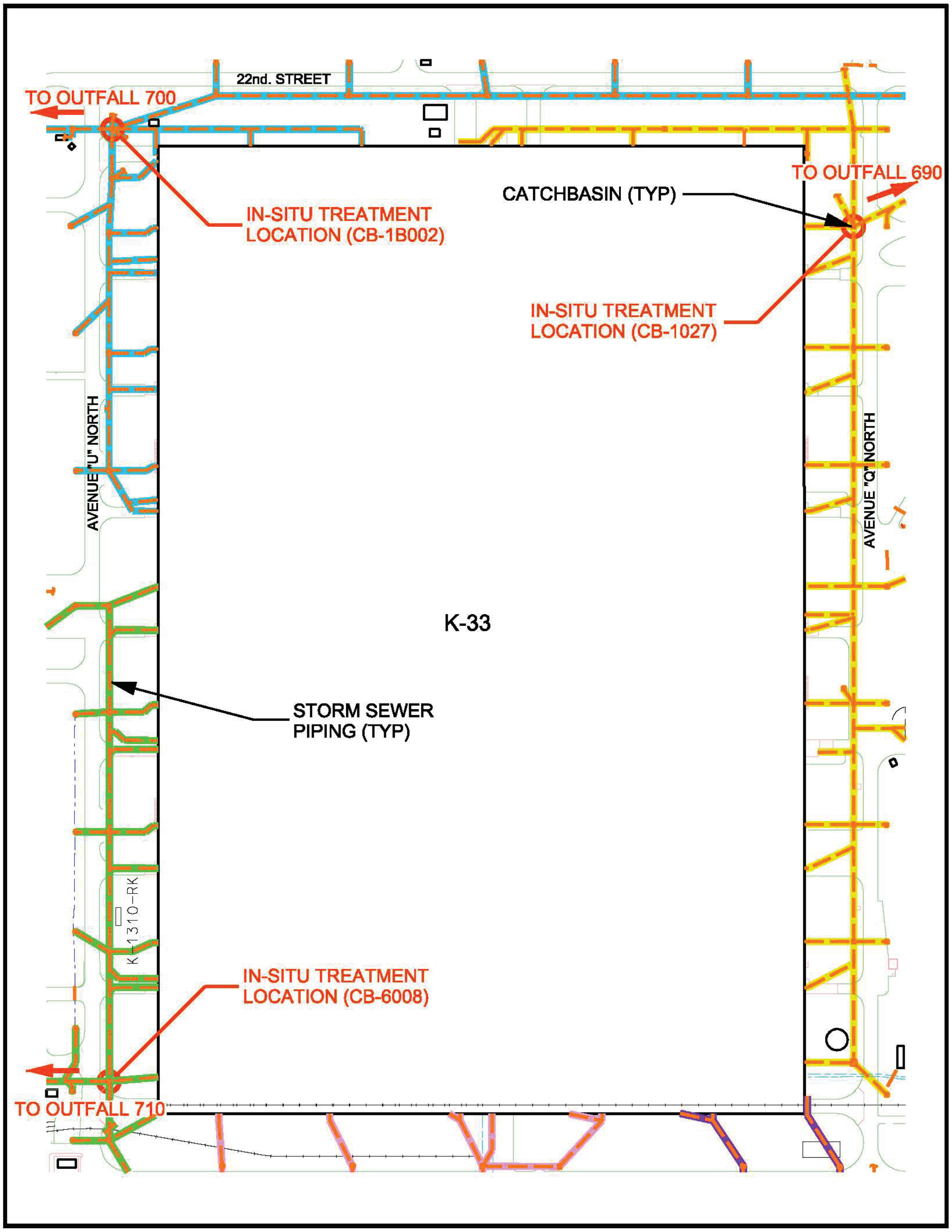


Fig. 3.31. Locations of conditioning systems relative to K-33 building footprint.

3.5.2.5 Sampling of Legacy Chromium Groundwater Plume Discharge

The release of hexavalent chromium into Mitchell Branch from the storm drain 170 outfall and from seeps at the headwall of the storm drain 170 discharge point resulted in levels of hexavalent chromium that exceeded State of Tennessee ambient water quality criteria (AWQC). Immediately below storm drain 170, hexavalent chromium levels were measured at levels as high as 0.78 mg/L, which exceeded the State of Tennessee hexavalent chromium water quality chronic criterion of 0.011 mg/L for the protection of fish and aquatic life. The elevated hexavalent chromium levels at the storm water 170 outfall were first detected in October 2007.

Total chromium was at about the same level, indicating that the chromium was almost completely hexavalent chromium at the release point. On July 20, 2007, TDEC sent an NOV to DOE for the hexavalent chromium release, and DOE responded on August 3, 2007.

Because chromium has not been used at ETTP for more than 30 years, the release of hexavalent chromium into Mitchell Branch was a legacy problem and not an ongoing operations problem. Therefore, DOE determined that the appropriate response to this release was a CERCLA time-critical removal action. On November 5, 2007, DOE notified EPA and TDEC of its intent to conduct a CERCLA time-critical removal action to install a grout barrier wall and groundwater collection system to intercept the chromium-contaminated water discharging from the storm drain 170 outfall and headwall seeps into Mitchell Branch.

The purpose of the "Action Memorandum for Reduction of Hexavalent Chromium Releases into Mitchell Branch at the East Tennessee Technology Park, Oak Ridge, Tennessee," was to abate an immediate potential threat to public health and the environment from hexavalent chromium releases into Mitchell Branch. The potential for a chronic impact on the fish and aquatic life in Mitchell Branch may have increased in the future if the hexavalent chromium release had been allowed to continue.

The biological monitoring results did not indicate that the chromium had a significant, acute impact on fish or aquatic life in Mitchell Branch since the elevated levels of chromium were identified. However, there was a concern that the elevated levels may have begun to have a chronic impact on the fish and aquatic life in Mitchell Branch if the hexavalent chromium releases had not been addressed in a timely manner.

The time-critical removal action was undertaken by DOE, as lead agency, pursuant to CERCLA Section 104(a) and the *Federal Facility Agreement for the Oak Ridge Reservation*, Section XIII (DOE 1994). In accordance with 40 *CFR* 300.415(j) and DOE guidance, on-site removal actions conducted under CERCLA are required to meet applicable or relevant and appropriate requirements (ARARs) to the extent practicable considering the exigencies of the situation. The AWQC for hexavalent chromium for the designated uses for Mitchell Branch were ARARs for the limited scope of this action and were included in the action memorandum.

DOE complied with the ARARs and "to-be-considered" guidance, as set forth in the action memorandum, to the extent practicable. The ambient water quality chronic criteria for hexavalent chromium during dry weather base flow periods were not met with the initial action. The action reduced the level of hexavalent chromium in Mitchell Branch by about 98% from 0.78 mg/L to levels as low as 0.014 mg/L during worst-case dry weather base flow periods. During wet weather periods, the level of hexavalent chromium in Mitchell Branch was reduced from 0.025 mg/L to current levels that are typically below method detection thresholds of 0.006 mg/L. The time-critical removal action is documented in the *Removal Action Report for the Reduction of Hexavalent Chromium Releases into Mitchell Branch at the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE 2001a).

Since the removal action report was issued, additional improvements to the collection system have been implemented. The original pneumatic groundwater collection system pumps had a maximum capacity of about 8 to 9 gal/min, and the pumps required frequent field maintenance to keep them operating at the maximum rate. In January 2009 electric pumps were installed as replacements for the pneumatic pumps, and the new pumps have a combined maximum pump rate in excess of 20 gal/min. The new pumps have been set at an operational rate of 12 gal/min, which is a rate at which the hexavalent chromium levels in Mitchell Branch consistently have been below the ambient water quality criterion of 0.011 mg/L.

Traditionally the water from the chromium collection system has been treated at CNF, which has provided adequate treatment to reduce levels of hexavalent chromium in Mitchell Branch to the extent mentioned earlier. It is expected that CNF will soon be replaced by a smaller CERCLA-regulated facility called the Chromium Water Treatment System (CWTS). The CWTS facility was constructed and testing was initiated in 2011. For a brief period at the end of December 2011, CWTS received the chromium collection system water. Functional testing is still being performed on CWTS, and CNF continues to treat the chromium collection system water.

To monitor the continued effectiveness of the collection system, periodic monitoring continued as part of the 2011 SWP3. Samples were collected at piezometer TP-289, K-1407-V hose, Outfall 170, and Mitchell Branch kilometer (MIK) 0.79 (Fig. 3.32). Samples collected at TP-289 directly monitor the concentrations of chromium in the contaminated groundwater plume. Samples collected from the K-1407-V hose monitor the chromium in the water recovered by the groundwater collection system. Samples collected at Outfall 170 monitor the concentrations of chromium being discharged directly to Mitchell Branch. Samples at MIK 0.79 monitor chromium concentrations in Mitchell Branch after water discharged from Outfall 170 has had a chance to mix with other flow in the branch.

Samples at these locations were collected on a monthly basis during either wet or dry weather conditions on an alternating basis. Samples were monitored each month for total chromium and on an "as requested basis" for hexavalent chromium at least two times during the year. All of the samples collected as part of this effort were collected using the manual grab sampling method. Manual grab samples were collected according to the guidelines specified in Sections 3.1.2 and 3.3.1 of EPA's *NPDES Storm Water Sampling Guidance Document* (EPA 1992) and applicable procedures that have been developed by the sampling subcontractor. All guidelines stated in this SAP concerning sample documentation, analytical procedures, QA/quality control (QC), etc. were followed as part of this sampling effort.

The analytical data indicate that chromium levels may fluctuate slightly at the TP-289 and K-1407-V hose but are relatively consistent over the long term. Chromium values at Outfall 170 and MIK 0.79 have much more variability. This is most likely due to the greater variability in flow rates at these two locations.

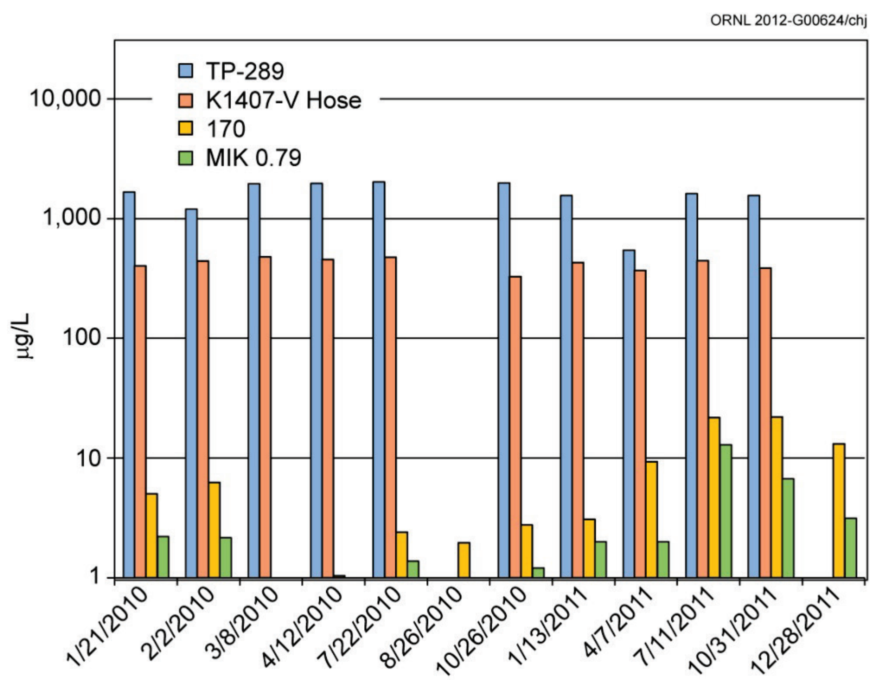


Fig. 3.32. Chromium results from sampling upstream and downstream of the chromium collection system.

3.5.2.6 Investigation of Mercury at East Tennessee Technology Park

Mercury activities at ETTP included use, handling, and recovery operations. Mercury use and handling were common in such equipment as manometers, switches, mass spectrometers, mercury diffusion pumps, mercury traps, and laboratory operations. Process buildings contained many of these manometers, thermometers, and switches. Large quantities of mercury-bearing wastes from the on-site gaseous diffusion plant operations and support buildings, ORNL, and Y-12 were processed and stored at ETTP. Mercury from soils and spill cleanups were processed on-site as well. Mercury recovery operations were conducted in a number of buildings, as shown on Fig. 3.33. Many buildings were located in watersheds that discharged primarily to Mitchell Branch.

The current NPDES permit requires quarterly mercury sampling to be performed at storm water Outfalls 05A, 170, 180, and 190. These four locations were selected because the permit application information indicated that mercury levels at these outfalls exceeded the AWQC level of 51 ng/L. Outfall 05A is the discharge point for the former sewage treatment plant drainage basin into Poplar Creek on the east side of ETTP. Outfalls 170, 180, and 190 collect storm water from large areas on the north side of ETTP and discharge to Mitchell Branch.

To obtain analytical data using a more sensitive method and to identify how the discharges from the storm water outfalls might be affecting the water quality of Mitchell Branch, Poplar Creek, and associated waterways, mercury sampling was performed at numerous storm water outfalls with known historical mercury activities; surface water and sediment sampling were also performed.

As stated above, the applicable water quality criterion for mercury is 51 ng/L (0.051 μg/L); therefore, total mercury samples were analyzed by a laboratory with a method detection limit for mercury below this criterion. For the storm water and surface water samples, EPA 1631 (EPA 2002) was used for total mercury analysis because its use results in detection levels below the water quality criterion. Depending on the laboratory that performs the analysis, the EPA 1631 method has a detection limit as low as 0.2 ng/L. Surface water samples are collected in dry weather conditions, unless otherwise specified. Storm water samples are collected during both wet and dry weather conditions. Wet weather samples are collected from flows resulting from a storm event greater than 0.1 in. in magnitude in 24 h and that occurs at least 72 h after any previous storm event of 0.1 in. or greater in 24 h. If an intermittent rainfall occurs over a period of 24 h and does not equal or exceed 0.1 in., it is not considered to be a storm event, and the 72 h delay until the next rainfall that can potentially be sampled is not in effect. Dry weather samples are collected at least 72 h after a storm event of 0.5 in. or greater. All dry weather samples are collected by the manual grab sampling technique. Current permit and permit renewal application samples are collected using automated sampling equipment consisting of at least three aliquots taken during the first 60 min of a storm event discharge.

For sediment samples, the laboratory method used for total mercury is EPA SW-846, Method 7471A (EPA 1994). Sediment samples are collected by the manual grab sampling technique.

Results for storm water Outfalls 170, 180, and 190 and associated catch basins for each network are shown in Figs. 3.34–3.36. Mercury results for Outfall 170 and the associated catch basins appear to be well below the water quality criteria (WQC) since July 2009. For 2011, the results for Outfall 170 ranged from 3.18 to 6.8 ng/L, which is well below the WQC. Outfalls 180 and 190 and the associated catch basins appear to be the primary sources of mercury discharges into Mitchell Branch in relation to the buildings in those drainage areas with historical mercury processes. For 2011, the results for Outfall 180 varied significantly, ranging from 28.1 to 456.6 ng/L. For 2011, the results for 190 ranged from 12.3 to 103 ng/L. Outfall 180 appears to have fluctuations in mercury levels that are significantly higher than Outfalls 170 and 190. This may be due in part to continued infiltration within the drainage system, primarily from catch basins 8131 and 8041A, which drain the areas occupied by the former mercury processes in Buildings K-1303 and K-1401.

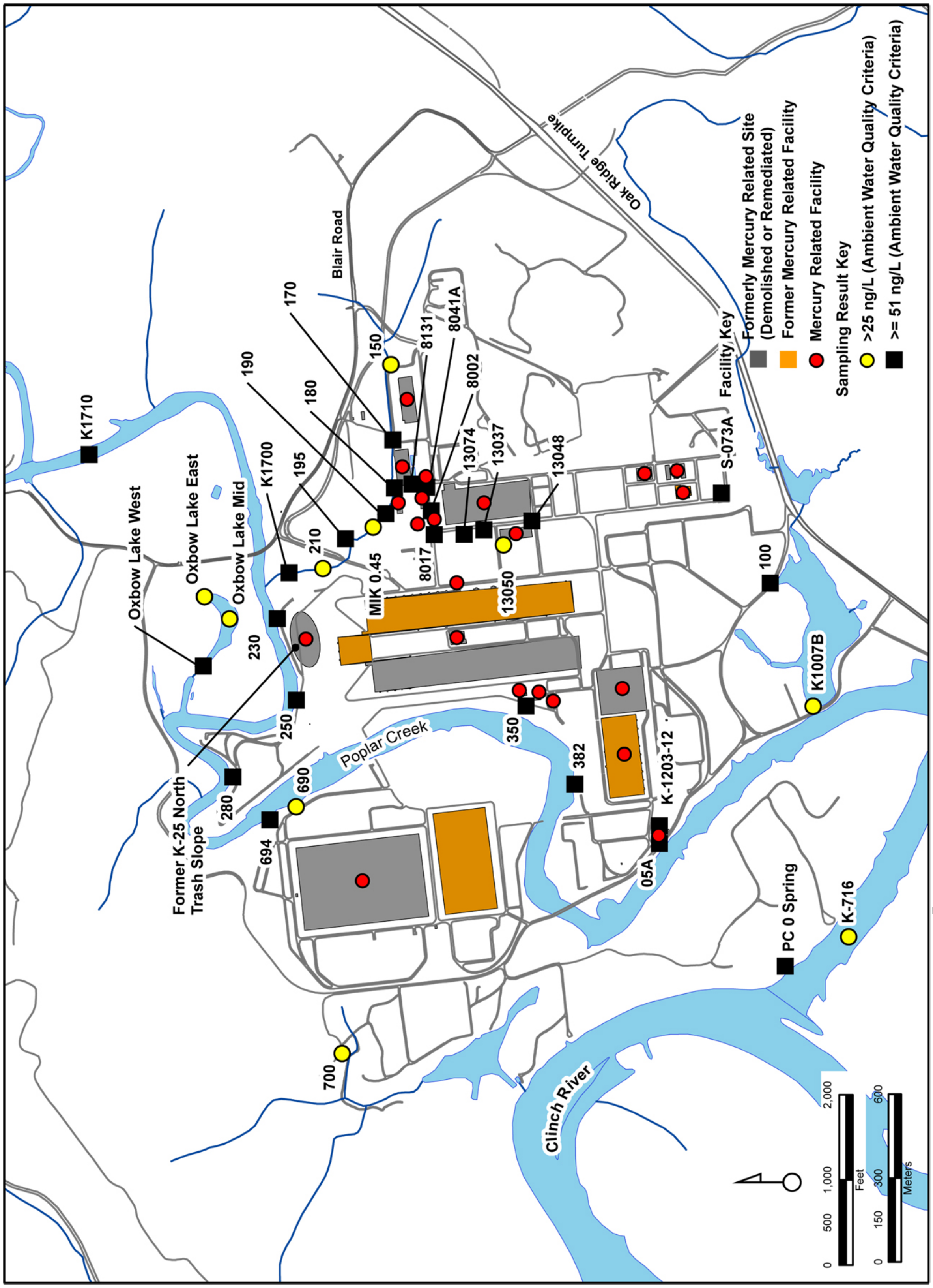


Fig. 3.33. East Tennessee Technology Park area plan showing mercury-related facilities and mercury levels in water samples.

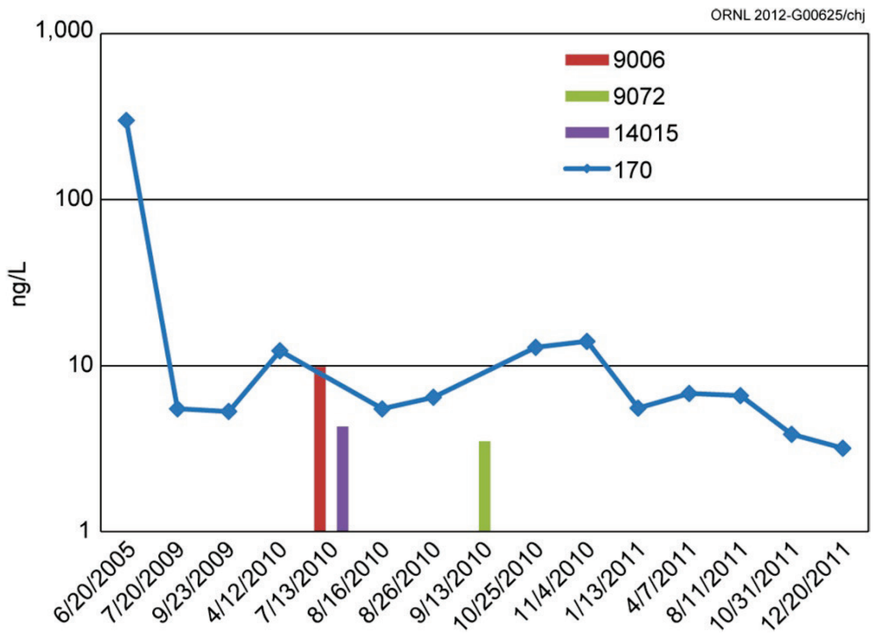


Fig. 3.34. Outfall 170 network water results for mercury.

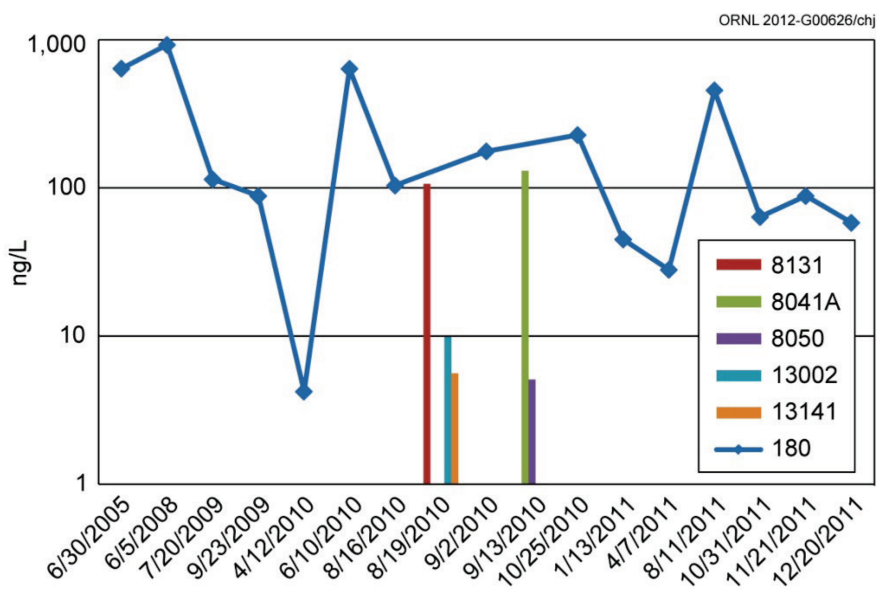


Fig. 3.35. Outfall 180 network water results for mercury.

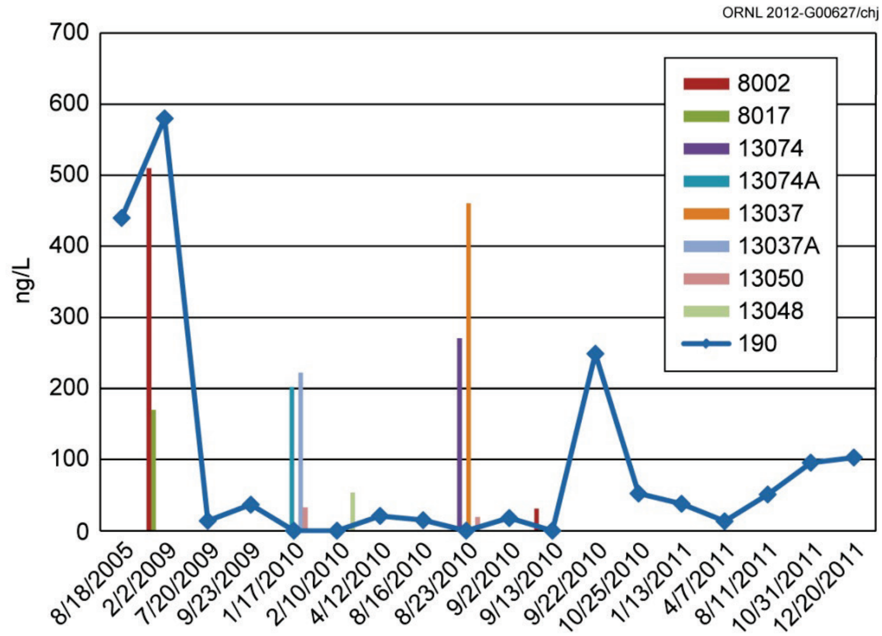


Fig. 3.36. Outfall 190 network water results for mercury.

Likely sources of mercury discharges in the Outfall 180 drainage system are Buildings K-1401 and K-1405-7 and the K-1407-B pond. The most likely sources of mercury discharges in the Outfall 190 drainage system are operations conducted in Buildings K-1035, K-1218, K-1301, K-1302, K1303, K-1401, and K-1413. By contrast, the mercury discharges in the Outfall 170 drainage system would be from K-1420; however, the remediation of this area appears to have resulted in mercury levels below the WQC in contrast to the other two outfalls of Mitchell Branch.

The Mitchell Branch instream monitoring locations for mercury are shown in Fig. 3.37. Monitoring of this area was performed on May 10, 2011. Table 3.17 indicates data for those monitoring locations downstream of MIK 1.4 to slightly downstream of the K-1700 weir for this sampling event. Further monitoring will be performed in 2012 to investigate for possible seeps and infiltration.

Figure 3.38 shows the Mitchell Branch instream sediment results for mercury along a specific area of concern from MIK 0.27 to MIK 0.33. This was investigated upon review of the results shown in Table 3.17 because of an obvious decrease in mercury levels at the locations further downstream compared to the levels at the upstream locations. No specific conclusions were drawn, and further investigation is necessary to explain the sediment results in this area; however, differences in the deposition or erosion of sediment containing elevated mercury levels at the different locations along this stretch is one possible explanation.

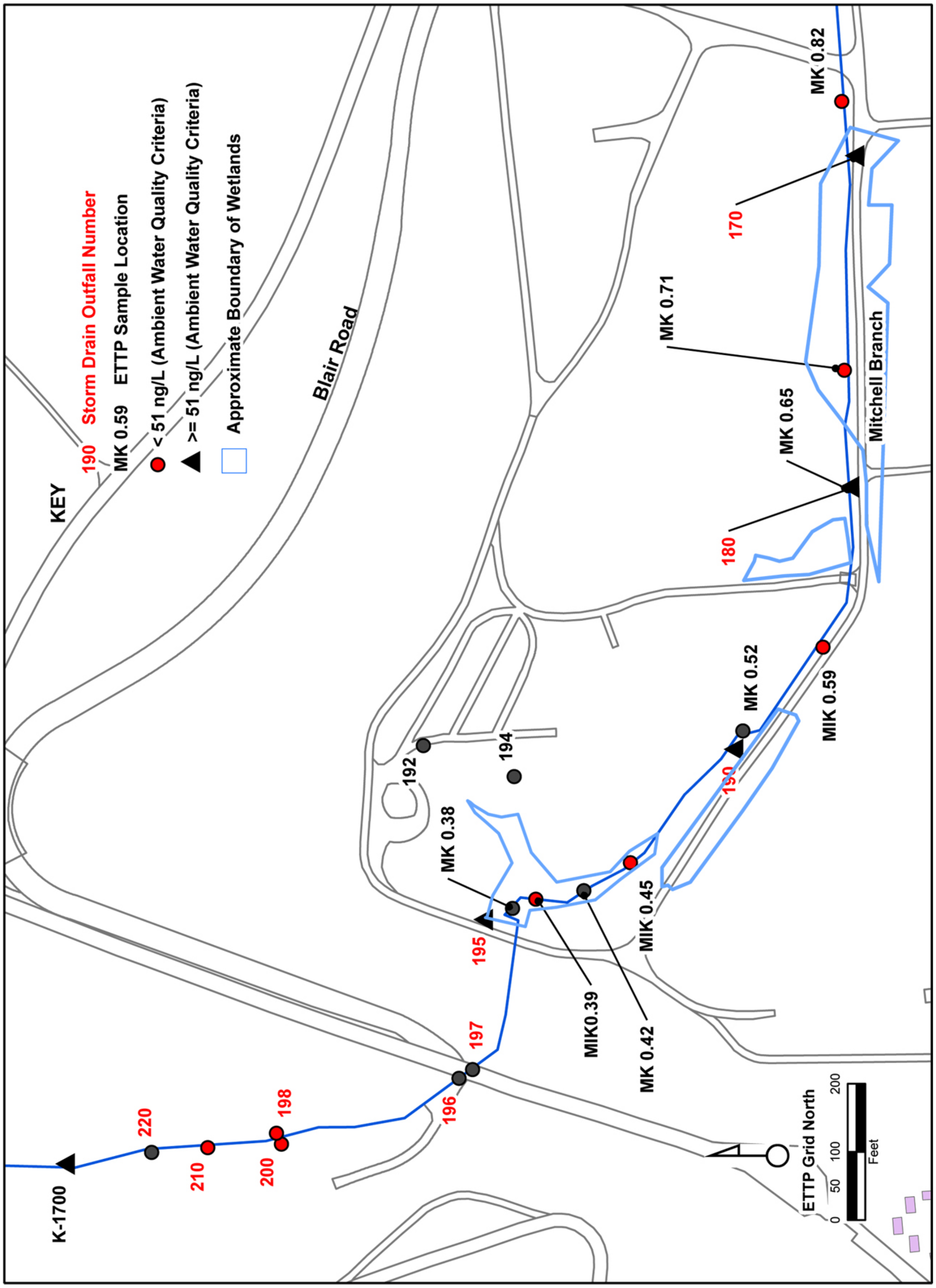


Fig. 3.37. Mitchell Branch instream water monitoring locations and results for mercury.

Table 3.17. Mitchell Branch instream maximum mercury monitoring results on May 10, 2011

Mitchell Branch Location	Maximum Instream Water Results for Mercury (ng/L)	Mitchell Branch Location	Maximum Instream Water Results for Mercury (ng/L)
MIK 0.084	**51.1***	MIK 0.27	45.8
MIK 0.099	47.8	MIK 0.33	15.9
K-1700 weir	49.9	MIK 0.38	10.8
MIK 0.14	**51.2**	MIK 0.39	11.5
MIK 0.15	49.7	MIK 0.42	8.5
MIK 0.17	48	MIK 0.45	7.8
MIK 0.18	45.5	MIK 0.52	7
MIK 0.2	**52**	MIK 0.59	5.7
MIK 0.21	44.4	MIK 0.65	7.5
MIK 0.23	42.4	MIK 0.71	3.8
MIK 0.24	42.2	MIK 0.78	4.1
MIK 0.26	47.2	MIK 0.83	3.6

*Bolded entries are those above Tennessee Water Quality Criteria.
Abbreviations
MIK = Mitchell Branch kilometer

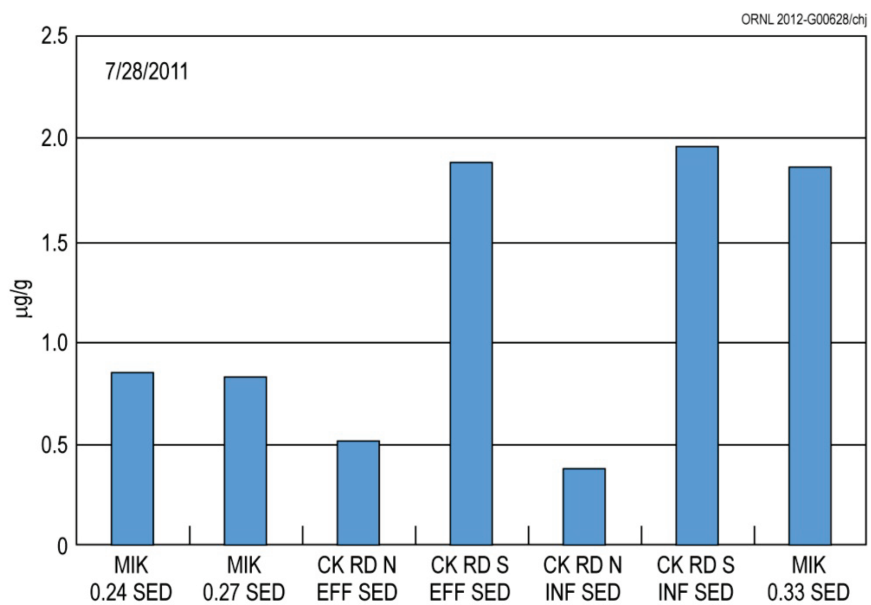


Fig. 3.38. Mitchell Branch instream sediment results for mercury.

The K-1700 water results for mercury (Fig. 3.39) were fairly steady from 2008 through 2009 but became more erratic in 2010, before decreasing below WQC levels by the end of October 2011.

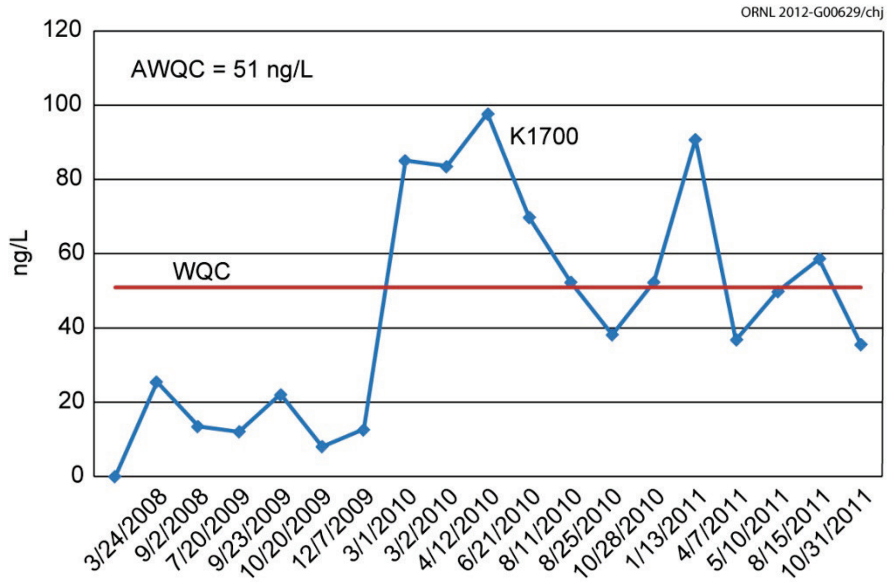


Fig. 3.39. The K-1700 water results for mercury.

Another area of elevated mercury levels is the site of the former sewage treatment plant and associated storm water Outfall 05A. As stated above, storm water Outfall 05A requires quarterly mercury sampling because the permit application information indicated that mercury levels at this location exceeded the WQC level of 51 ng/L. Outfall 05A is the discharge point for the former sewage treatment plant drainage basin. Operations at the plant ceased in 2008. Figure 3.40 indicates the locations of the storm water Outfall 05A, the K-1203-10 sump, and seven groundwater wells that have been monitored for mercury. Additionally, a manhole (05A-JCT) was monitored in association with the abandoned line leading into the north side of the K-1203-10 sump. Table 3.18 shows a comparison of mercury levels between the influent and effluent sources as well as the soil samples taken around the sump.

Fig. 3.40. The former sewage treatment plant mercury monitoring locations.

Table 3.18. Water and soil mercury results for the former sewage treatment plant

Water influent to K-1203-10 sump (ng/L)			Water effluent at Outfall 05A (ng/L)		Soil around K-1203-10 sump (ng/g)		
11/16/2010	05A-A	82.7	3/21/2006	140	05A-A	6/20/11	327
3/9/2011	05A-A	30.2	10/22/2007	108	05A-C	6/20/11	1341.7
9/6/2011	05A-A	33.5	6/26/2008	205			
11/16/2010	05A-B	37.5	8/26/2008	135			
1/17/2011	05A-B	29.4	4/12/2010	186			
11/16/2010	05A-C	12.8	8/16/2010	66.4			
3/9/2011	05A-C	178.4	8/26/2010	118			
9/6/2011	05A-C	25.8	10/25/2010	223			
11/16/2010	05A-D	294.8	1/17/2011	79.1			
1/17/2011	05A-D	106.6	4/7/2011	71.1			
3/9/2011	05A-E	12.9	7/11/2011	78.1			
9/6/2011	05A-E	24.1	10/31/2011	137			
9/6/2011	05A-JCT	3.7					

The influent water coming into the K-1203-10 sump was monitored from five sources in 2011.Two sources (05A-A, 05A-C, and 05A-E) are naturally occurring sheet flows coming into the sump. The other two sources (05A-B and 05A-D) are pipe flow sources. The pipeline for 05A-B is abandoned and runs from the clarifying basin to manhole 05A-JCT to the sump. The pipeline for 05A-D is labeled on historical drawings as being partially abandoned and runs about 65–70 ft from the chlorine contact basin (K-1203-8). Two of the influent sources coming into the sump (05A-C and 05A-D) were above WQC in 2011; the highest mercury result to date was 294.8 ng/L at 05A-D. All five influent sources are to be resampled for mercury in 2012.

Figure 3.41 indicates the mercury results in the effluent water at Outfall 05A since 2006. As shown, all results for the past 5 years are above WQC. In 2011, specifically, Outfall 05A was monitored four times; the highest mercury result was 137 ng/L on October 31, 2011. Additional monitoring was performed for the former sewage treatment plant area in 2011 as described previously.

Four groundwater wells were monitored in 2011—three unconsolidated wells (UNW-041, UNW-042, UNW-085) and one bedrock well (BRW-057). Only the bedrock well had a result above WQC: 68.7 ng/L; however, the origin of the mercury is not known due to the karst topography of the area. Three other unconsolidated wells will be monitored in March 2012: UNW-086, UNW-087, and UNW-096.

Table 3.19 shows the results for other 2011 storm water monitoring at ETTP outfalls with mercury results above WQC. Storm water Outfall 210 is located upstream of Mitchell Branch K-1700 weir before Poplar Creek and receives storm water discharges from the northeast side of Building K-25, where it is possible mercury contamination may have occurred. Storm water Outfall 250 is located north of the K-25 Building and empties into Poplar Creek. The drainage area for this outfall includes three main structures, a pump house and two cooling tower basins. There are no known mercury processes in this location.

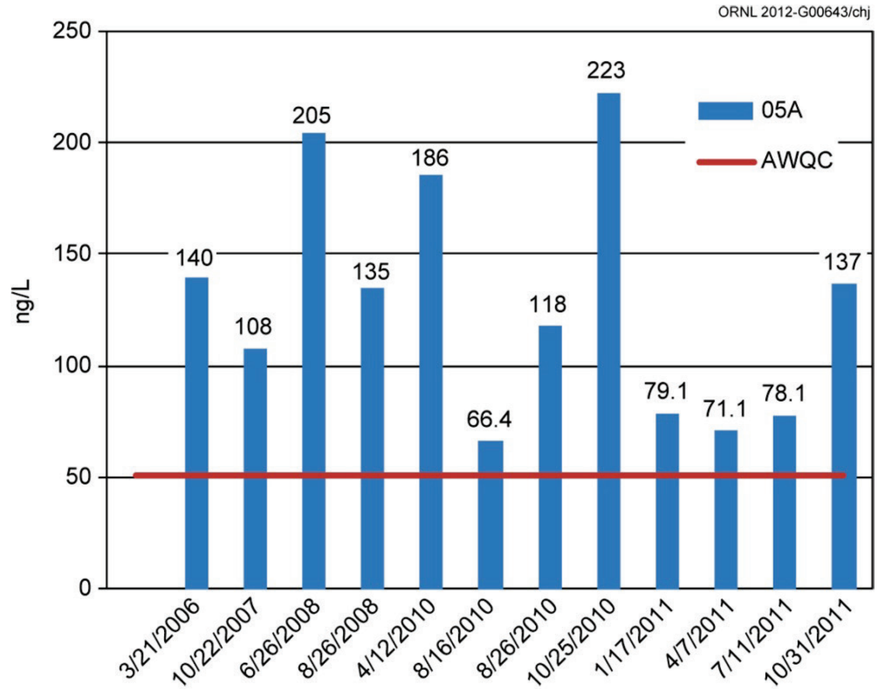


Fig. 3.41. Storm water Outfall 05A water results for mercury over the last 5 years.

Table 3.19. Storm water results of mercury monitoring in 2011 at other East Tennessee Technology Park locations above WQC

Storm water outfall	Date	Mercury result (ng/L)
210	12/6/2011	60.9
250	4/5/2011	379

Abbreviations
WQC = water quality criteria

In 2011, fish and caged clams were analyzed for mercury. For details of this study, please see Section 3.6.

Further monitoring for mercury is proposed in 2012 for the Mitchell Branch, the K-1203 former sewage treatment plant, and other locations as part of the NPDES permit program, SWP3, environmental monitoring program, groundwater program, and BMAP. Historical documents continue to be researched, and future monitoring is proposed as part of the ongoing mercury investigation.

3.5.2.7 NPDES Monitoring at the CNF Wastewater Treatment System

Wastewater from CNF is discharged through Outfall 001 into the Clinch River. Nonradiological monitoring of CNF effluent is conducted according to the requirements of NPDES permit number TN0074225. Monitoring requirements, frequencies, and sample types required under the permit changed during 2010 with the reissuance of the permit on December 1, 2010. During the permit renewal process, CNF was reclassified from the Metal Finishing category into the Centralized Wastewater Treatment category by the permit writer. This change in point source category was mainly responsible for the change in parameters between the previous permit and the renewed permit. The requirements for the 2010 permit are listed in Table 3.20.

Table 3.20. NPDES permit number TN0074225 Outfall 001 monitoring requirements

Parameter	Measurement frequency	Sample type
Flow	Continuous	Recorder
pH	Continuous	Recorder
^{137}Cesium	1/month	Monthly composite
^{234}Uranium	1/month	Monthly composite
^{235}Uranium	1/month	Monthly composite
^{236}Uranium	1/month	Monthly composite
^{237}Neptunium	1/month	Monthly composite
^{238}Plutonium	1/month	Monthly composite
^{238}Uranium	1/month	Monthly composite
^{239}Plutonium	1/month	Monthly composite
^{99}Technetium	1/month	Monthly composite
COD	1/month	24 h composite
Gross alpha radioactivity	1/month	Monthly composite
Gross beta radioactivity	1/month	Monthly composite
Oil and grease	1/month	Grab
Other radionuclides contained in wastewater[a]	1/month	Monthly composite
Uranium, total	1/month	Monthly composite
2-4-6-Trichlorophenol	1/quarter	24 h composite
Acetone	1/quarter	Grab
Acetophenone	1/quarter	24 h composite
ICP metals[b]	1/quarter	24 h composite
Methyl ethyl ketone (2-Butanone)	1/quarter	Grab
o-Cresol (2-methyl phenol)	1/quarter	24 h composite
p-Cresol (4-methyl phenol)	1/quarter	24 h composite
Phenol	1/quarter	24 h composite
Pyridine	1/quarter	24 h composite
Trichloroethylene	1/quarter	Grab
TSS	1/quarter	24 h composite
BOD	1/year	24 h composite
Chloroform	1/year	Grab
Mercury, Methyl	1/year	Grab
Mercury, total	1/year	24 h composite
PCBs	1/year	24 h composite

[a]Other radionuclides currently being analyzed each month are ^{241}Am, ^{3}H, ^{14}C, ^{230}Th, ^{234}Th, ^{60}Co, and ^{131}I.

[b] ICP metals shall include, at a minimum, Sb, As, Cd, Cr, Co, Cu, Pb, Ni, Ag, Sn, Ti, V, and Zn per the permit and Al, Ba, Be, B, Ca, Fe, Mg, Mn, Mo, K, Se, Si, Na, and Tl.

Abbreviations

BOD = biochemical oxygen demand
COD = chemical oxygen demand
ICP = inductively coupled plasma
PCB = polychlorinated byphenyl
TSS = total suspended solids

Radiological sampling of effluent from CNF is conducted weekly according to the requirements of NPDES permit number TN0074225. The weekly samples are then composited into a single monthly sample. Table 3.21 lists the total discharges in 2011 by isotope. The radiological results are compared with the DCGs. The sum of the fractions must be kept below 100% of the DCGs; in practice the effluent results from CNF were well below 100% of the DCGs until 2007. Figure 3.42 shows a rolling 12-month average for 2011. Monitoring results for 2011 showed a marked decrease in the rolling 12-month average of the sum of the fractions of the DCGs from a high of 1.1 in January 2008 to 0.25 in December 2011. In most of 2011, the rolling average of the sum of the fractions has gradually decreased from 0.35 to 0.25. The cessation of waste-burning activities at the TSCA Incinerator may account for much of the decrease. Other factors include changes in operations at the facility to enhance the removal efficiency.

Table 3.21. Isotopic discharges from the Central Neutralization Facility Wastewater Treatment System, 2011

Isotope	Discharge (Curies)	Isotope	Discharge (Curies)
^{241}Am	1.7E–1	^{230}Th	5.2E–1
^{137}Cs	4.8E–1	^{234}Th	4.0E+1
^{60}Co	1.1E+0	^{234}U	5.8E+1
^{131}I	4.5E+0	^{235}U	5.2E+0
^{237}Np	5.0E–2	^{236}U	5.2E+0
^{238}Pu	2.4E–7	^{238}U	4.0E+1
^{99}Tc	5.0E+2		

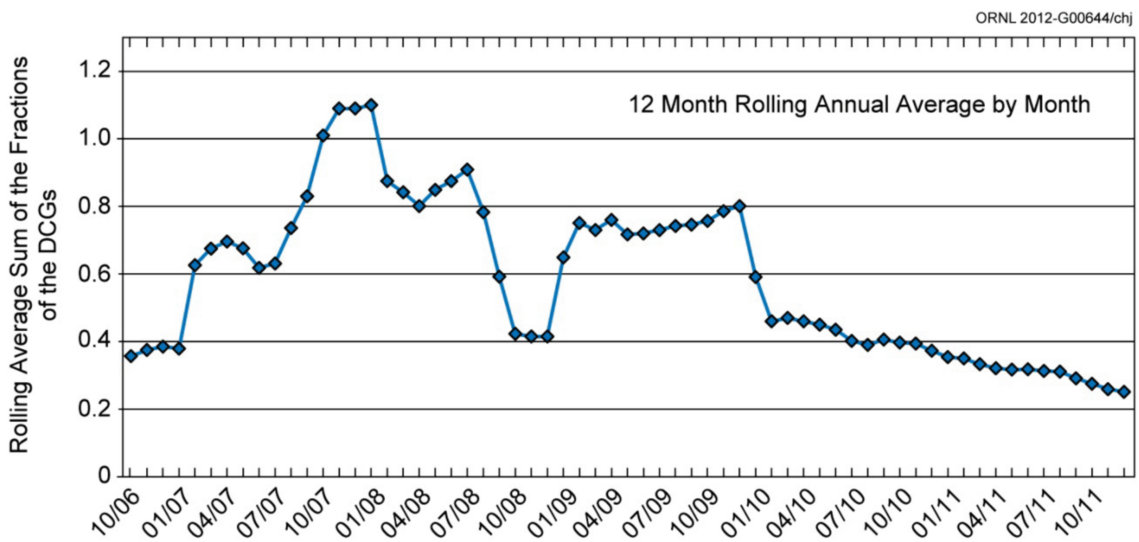


Fig. 3.42. CNF/K-1435 Wastewater Treatment System radionuclide liquid discharges.

Although uranium isotopes constitute a greater mass (about 5.8 kg) of radionuclides discharged from CNF, ^{99}Tc accounts for the greatest activity due to its much higher specific activity. Transuranic isotopes constitute a small fraction of the total in the rolling 12-month average of the sum of the fractions of the DCGs from a high of 1.1 in January 2008 to 0.25 in December 2011. In most of 2011, the rolling average of the sum of the fractions has gradually decreased from 0.35 to 0.25. The cessation of waste-burning activities at the TSCA Incinerator may account for much of the decrease. Other factors include changes in operations at the facility to enhance the removal efficiency.

3.5.2.8 NPDES Permit Noncompliances

During 2011 ETTP and UCOR operations were conducted in compliance with contractual and regulatory environmental requirements. There were two NPDES permit noncompliances in 2011.

3.5.3 Surface Water Monitoring

During 2011 ETTP environmental monitoring program personnel conducted environmental surveillance activities at 13 surface water locations (Fig. 3.43) to monitor groundwater and storm water runoff (K-1700, K-1007-B, and K-901-A) or ambient stream conditions [Clinch River kilometer (CRK) 16; CRK 23; K-1710; K-716; K-700 Slough; and MIK 0.5, 0.6, 0.7, 0.8, and 1.4]. Depending on the location, samples were collected and analyzed for radionuclides quarterly (K-1700 and MIK 0.5, 0.6, 0.7, 0.8, and 1.4) or semiannually (remainder of locations). Results of radiological monitoring are compared with the DCGs. Radiological data are reported as fractions of DCGs for reported radionuclides. If the sum of DCG fractions for a location exceeds 100% for the year, a source investigation is required. Sources exceeding DCG requirements would need an analysis of the best available technology to reduce the sum of the fractions of the radionuclide concentrations to their respective DCGs to less than 100%. Comparisons with DCGs are updated regularly to maintain an annual average. The monitoring results at several locations were less than 1% of the allowable DCG (Fig. 3.44). The exceptions are K-1700 and four locations on Mitchell Branch, as indicated by the sums of the fractions of the DCGs for these locations: K-1700—1.9%, MIK 0.5—2.3%, MIK 0.6—1.9%, MIK 0.7—2.9%, and MIK 0.8—1.3%.

The percentage of the DCGs at K-1700 (1.9%) was slightly below the percentage of the 2010 monitoring results (2.2%).

Depending on the monitoring location, water samples may be analyzed for pH, selected metals, and VOCs. In 2011, results for most of these parameters were well within the appropriate Tennessee state WQC.

The WQC for dissolved oxygen in streams and ponds is a minimum level of 5 mg/L. On four occasions during the 2011 monitoring, dissolved oxygen levels at several of the surface water monitoring locations fell below this level. The lowest level (2.2 mg/L) was measured at K-901-A in June. Levels at MIKs 0.8 (twice at this location) and 1.4 were also measured at less than 5 mg/L at some point during 2011. Low levels of dissolved oxygen are not uncommon in area streams and are usually associated with higher temperatures (and the associated elevated levels of biological activity) and low rainfall and stream flow. No obvious signs of distress (e.g., dead fish) were observed to be associated with any of these measurements in 2011.

The WQC for mercury is 0.051 μg/L. On two occasions in 2011 levels of mercury were measured above this level in water collected from K-1700, and once in water collected from K-716 (a location in Poplar Creek). For details, please see the discussion of the sitewide mercury investigation given in Section 3.5.2.6.

Figures 3.45 and 3.46 illustrate the concentrations of TCE (trichloroethene, trichloroethylene) and total 1,2-DCE (dichloroethene, cis-1,2-dichloroethylene, trans 1,2-dichloroethylene) from the K-1700 weir (which is used to monitor Mitchell Branch), the only surface water monitoring location where VOCs are regularly detected. Concentrations of TCE and total 1,2-DCE are below the Tennessee WQC for recreation, organisms only (300 μg/L for TCE and 10,000 μg/L for trans 1,2-DCE, Appendix C, Table C.2), which are appropriate standards for Mitchell Branch. Moreover, the standards for 1,2-DCE apply only to the "trans" form of 1,2-DCE; almost all of the 1,2-DCE is in the cis-isomer. In addition, vinyl chloride has sometimes been detected in Mitchell Branch water (Fig. 3.47). VOCs have been detected in groundwater in the vicinity of Mitchell Branch and in building sumps discharging into storm water outfalls that discharge into the stream; however, storm drain network monitoring generally has not detected these compounds in the storm water discharges. When detected, the concentrations are lower than in the stream. Therefore, it appears that the primary source of these compounds is contaminated groundwater.

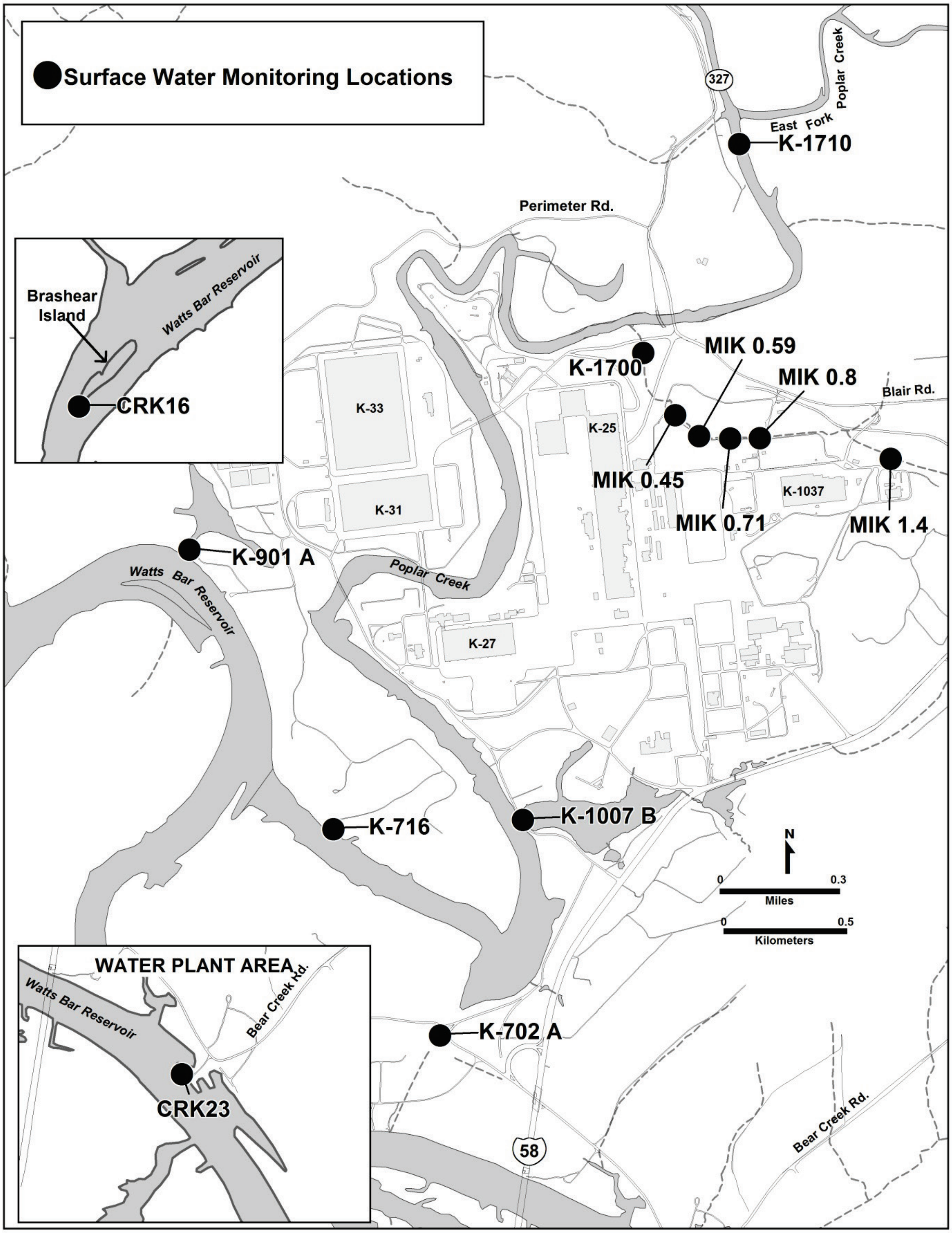


Fig. 3.43. Environmental monitoring program surface water monitoring locations.

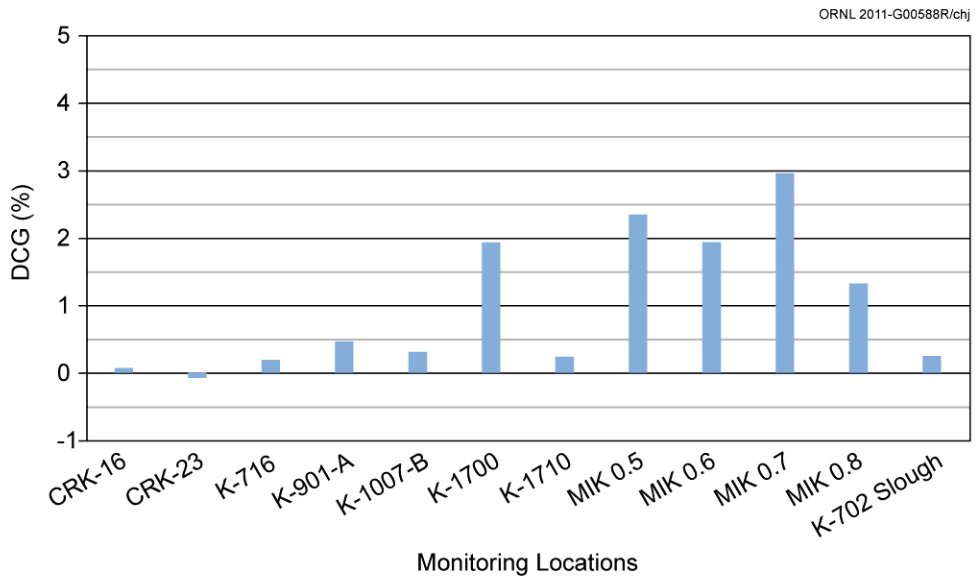


Fig. 3.44. Percentage of derived concentration guides (DCGs) at surface water monitoring locations, 2011.

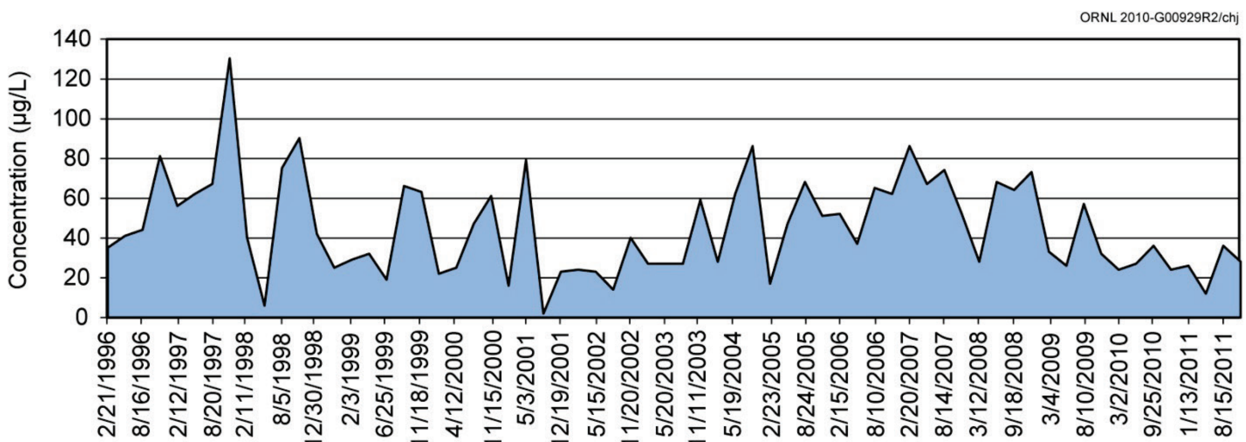


Fig. 3.45. Trichloroethene concentrations at K-1700.

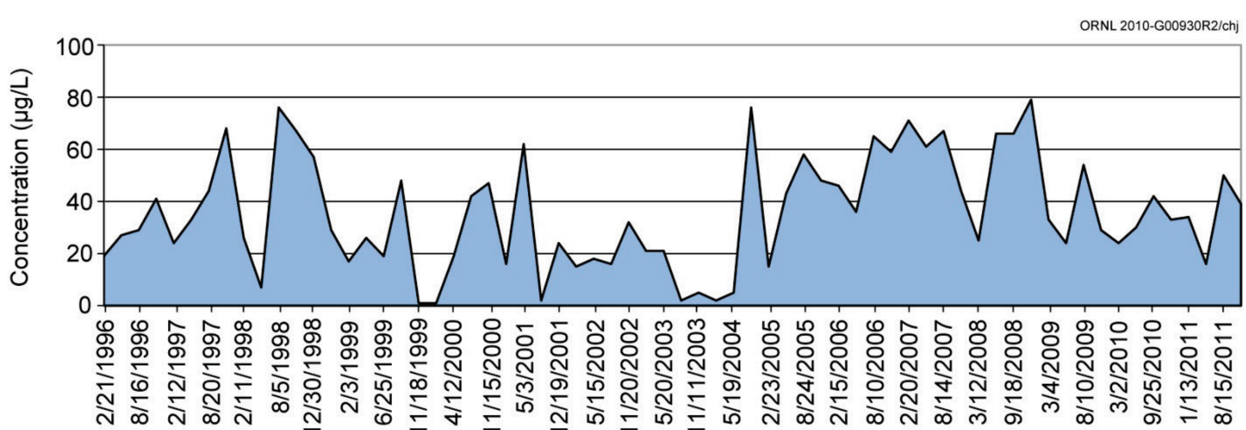


Fig. 3.46. 1,2-dichloroethene concentrations at K-1700.

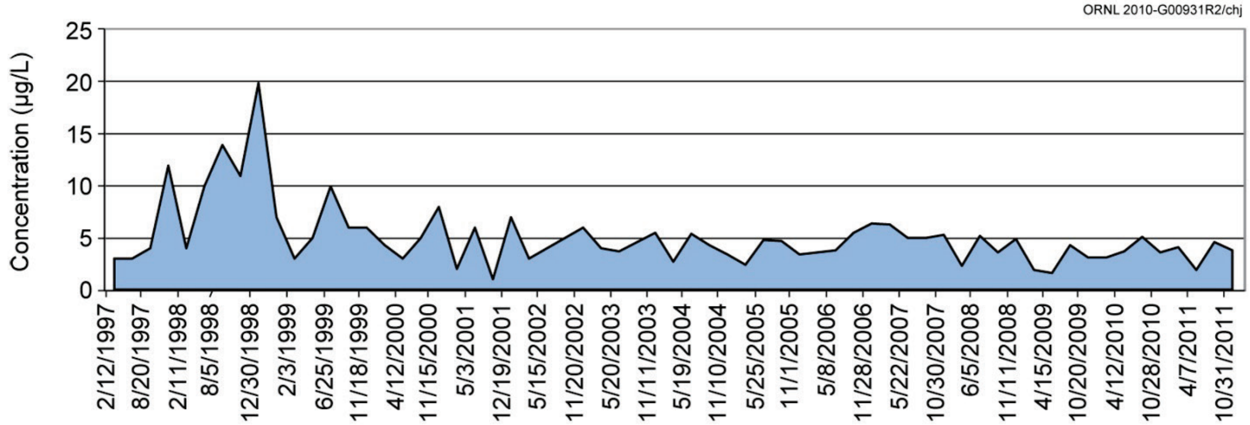


Fig. 3.47. Vinyl chloride concentrations at K-1700.

Surface water has been routinely sampled by DOE contractors and TDEC for several years as part of environmental monitoring programs. The DOE contractor surface water sampling program is conducted in accordance with DOE order surveillance program guidance. In data collected as part of the DOE contractor's sampling effort, dry weather levels of total chromium over the past 10 years (Fig. 3.48) have been shown to be generally less than 0.01 mg/L or, in some instances, at nondetectable levels. Results from routine surface water monitoring conducted in fall 2006 showed a significant increase in the total chromium level in Mitchell Branch, but it was still below the WQC for total chromium. Sampling performed in the spring of 2007 by DOE contractors and TDEC indicated that chromium levels had increased above the levels found in the fall 2006 sampling. A chromium collection system employing two extraction wells and pumps was installed to pump water from the vicinity of storm water Outfall 170 for treatment at CNF. Since this system was installed, chromium levels in Mitchell Branch have dropped dramatically, with levels being routinely measured at less than 3 µg/L. Hexavalent chromium levels in Mitchell Branch were all below the detection limit in 2011.

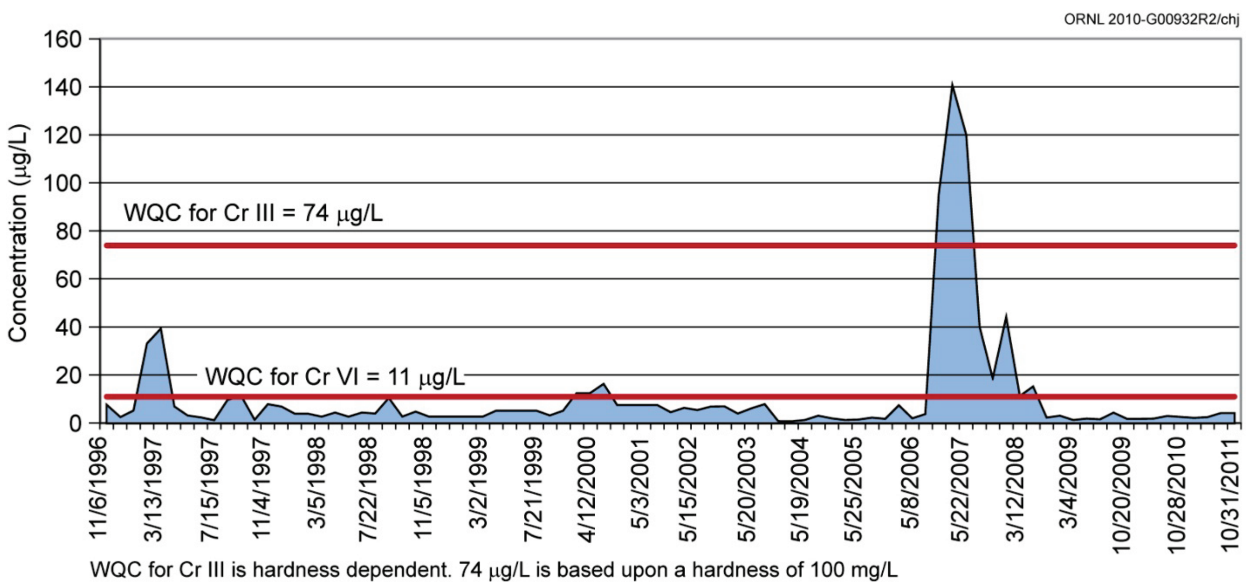


Fig. 3.48. Total chromium concentrations at K-1700.

3.5.4 East Tennessee Technology Park Groundwater

3.5.4.1 Introduction

Groundwater at the ETTP site occurs in residual soils, fill, alluvial soils, and bedrock. Because of the extensive terrain modification that occurred during site construction, large areas of the main industrial site were subjected to cut and fill activities that modified site hydrology. Most of the ETTP site is underlain by carbonate bedrock of the Chickamauga Group, with subordinate areas underlain by carbonates of the Knox Group and clastic dominated sandstones, shales, and siltstones of the Rockwood formation. The geologic structure of bedrock beneath the ETTP site is the most complex of the ORR facilities because of structural rock deformation associated with the White Oak Mountain thrust fault and footwall deformation associated with motion along that fault.

The ETTP groundwater monitoring program consists of (1) sitewide groundwater monitoring, primarily the monitoring of major site contaminant plumes and exit pathway contaminant migration, and (2) surface water monitoring for the analysis of AWQC. Results for 2011 are discussed in the following sections. An update on conditions as characterized by the biological monitoring in area surface water bodies is also included.

3.5.4.2 Background

The groundwater monitoring program at ETTP is focused primarily on investigating and characterizing sites for remediation under CERCLA, monitoring groundwater contaminant trends, and monitoring groundwater exit pathways. As a result of the FFA and certification of closure of the K-1407-B and -C ponds, the principal driver at the ETTP is CERCLA. ETTP Groundwater Protection Program requirements are incorporated into the DOE EM Water Resources Restoration Program (WRRP), established to provide a consistent approach to watershed monitoring across ORR and responsible for groundwater surveillance monitoring at ETTP, which includes groundwater exit pathway monitoring. This groundwater monitoring is conducted to assess the performance of completed CERCLA actions. Groundwater monitoring wells have been placed downgradient of potential contamination sources. Groundwater discharges into Poplar Creek, the Clinch River, and the three main surface water bodies at ETTP, the K-901 pond, K-1007 pond, and Mitchell Branch. Groundwater contaminants at ETTP migrate toward these surface water bodies. Groundwater monitoring wells have been placed near these exit points, and groundwater monitoring is supplemented by the ETTP Environmental Monitoring Plan surface water surveillance program.

At ETTP, surface water and groundwater hydrologic conditions differ from those typical of ORNL and the Y-12 Complex because of geologic and site development characteristics. At ETTP the surface water system involves several small, local streams that drain to Poplar Creek or directly to the Clinch River and extensive areas with dispersed surface runoff and groundwater seepage to the large water bodies. Groundwater is monitored primarily from constructed monitoring wells; however, sampling is also conducted at several springs or seeps where groundwater emanates to surface water bodies. Groundwater data pertaining to contaminant trends in the vicinity of CERCLA source areas and related to specific remedial actions are discussed in the 2011 remediation effectiveness report (RER) (DOE 2011). VOCs are the main contaminants of concern (COCs) at most of the groundwater monitoring locations and are discussed in further detail in the following sections. Very few of the compounds are used currently at ETTP, and the contamination in the plumes is due to legacy materials. The degree of degradation that has occurred over time is highly variable depending on the local groundwater geochemical conditions and the ability of indigenous microbes to degrade the chlorinated compounds. Radionuclides are a minor concern at locations downgradient of the remediated K-1070-A burial ground and K-1407-B and -C ponds sites. The 2011 RER (DOE 2011) includes summaries of the groundwater monitoring required for individual cleanup activities at ETTP and recommendations to modify requirements, as necessary, to ensure further protection of human health and the environment.

3.5.4.3 East Tennessee Technology Park Groundwater Monitoring at Major Site Contaminant Plumes

Extensive groundwater monitoring at the ETTP site has identified VOCs as the most significant groundwater contaminant on the site. To analyze the groundwater contaminant issues at ETTP, the remedial investigation/feasibility study (RI/FS) subdivided the site into several distinct areas–Mitchell Branch watershed, K-1004 and K-1200 area, K-27/K-29 area, and K-901 area (Fig. 3.49). Each of these areas has significant VOC contamination in groundwater. The principal chlorinated hydrocarbon chemicals that were used at ETTP were tetrachloroethene (PCE), TCE, and 1,1-dichloroethane (1,1-DCA).

Figure 3.49 shows the distribution and concentrations of the primary chlorinated hydrocarbon chemicals and their transformation products, respectively. Several plume source areas are identified within the regions of the highest VOC concentrations. In these areas, the primary chlorinated hydrocarbons have been present for decades and mature contaminant plumes have evolved. The degree of transformation or degradation of the primary chlorinated hydrocarbon compounds is highly variable across the ETTP site. In the vicinity of the K-1070-C/D source, a high degree of degradation has occurred, although a strong source of contamination still remains in the vicinity of the "G-Pit," where about 9,000 gal of chlorinated hydrocarbon liquids were disposed in an unlined pit. Other areas where transformation is significant include the K-1401 Acid Line leak site and the K-1407-B pond area. Transformation processes are weak or inconsistent at the K-1004 and K-1200 areas, K-1035, K-1413, and K-1070-A burial ground, and little transformation of TCE is observed in the K-27/K-29 source and plume area.

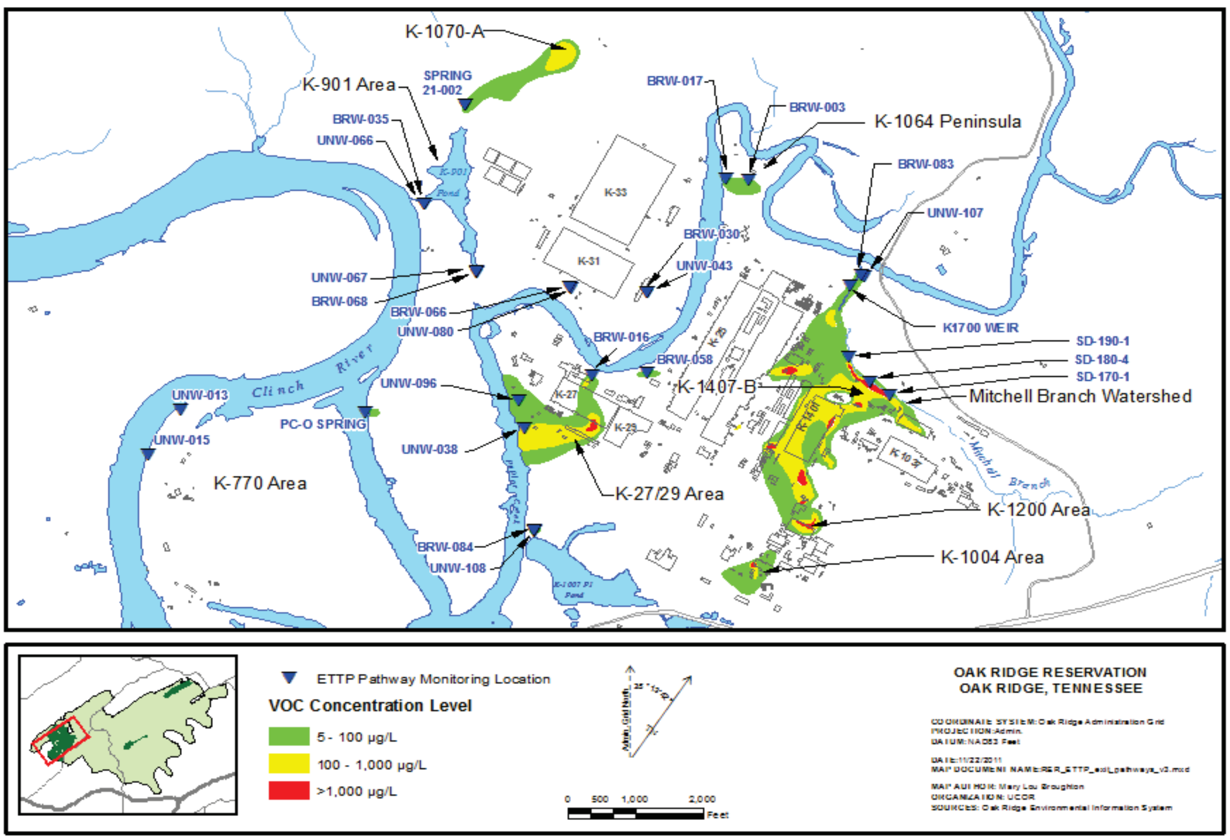


Fig. 3.49. East Tennessee Technology Park site exit pathway groundwater monitoring locations.

3.5.4.4 Exit Pathway Monitoring

Groundwater exit pathway monitoring sites are shown in Fig. 3.49. Groundwater monitoring results for the exit pathways are discussed below starting with the Mitchell Branch exit pathway and then progressing in a counterclockwise fashion.

The Mitchell Branch exit pathway is monitored using surface water data from the K-1700 weir on Mitchell Branch and wells BRW-083 and UNW-107. Figure 3.50 shows the detected concentrations of TCE, 1,2-DCE (essentially all cis-1, 2-DCE), and vinyl chloride at the K-1700 weir on Mitchell Branch from FY 1994 through FY 2011. These contaminants are the major contaminants in Mitchell Branch, although low concentrations of carbon tetrachloride, chloroform, and trichloroacetic acid (TCA) are sometimes detected. VOC concentrations measured during FY 2011 were consistent with previous years' result at the K-1700 weir.

Wells BRW-083 and UNW-107, located near the mouth of Mitchell Branch (Fig. 3.49), have been monitored since 1994. Table 3.22 shows the history and concentrations of detected VOCs in groundwater at the wells. Detection of VOCs in groundwater near the mouth of Mitchell Branch is considered an indication of the migration of the Mitchell Branch VOC plume complex. The intermittent detection of VOCs in this exit pathway is thought to be a reflection of variations in groundwater flowpaths that can fluctuate with seasonal hydraulic head conditions, which are strongly affected by rainfall. PCE and TCE were detected at concentrations greater than their respective maximum contaminant levels (MCLs) in BRW-083 during FY 2011 as a result of the above average rainfall from FY 2009 through 2011.

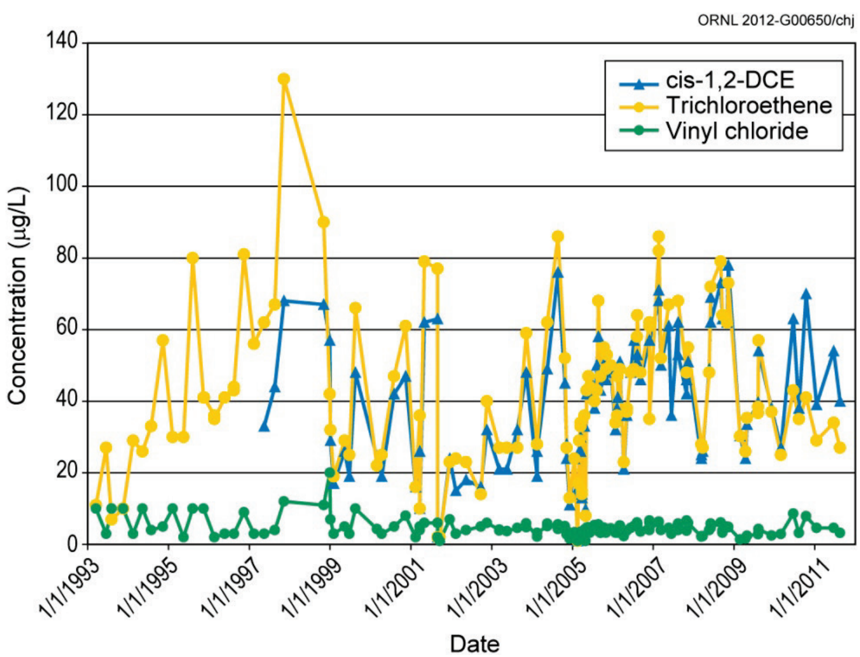


Fig. 3.50. K-1700 weir volatile organic compound concentrations.

Table 3.22. Volatile organic compounds detected in groundwater in the Mitchell Branch exit pathway (μg/L)[a]

Well	Date	cis-1,2-DCE	PCE	TCE	Vinyl chloride
BRW-083	8/29/2002	ND	**5**	**28**	ND
	3/16/2004	0.69	2.2	**9.9**	ND
	8/26/2004	2	4.7	**20**	ND
	3/14/2007	5	**9**	**28**	ND
	3/20/2008	ND	ND	ND	ND
	8/21/2008	ND	ND	ND	ND
	3/12/2009	ND	ND	1.31[c]	ND
	8/3/2009	ND	2.66	**14.2**	ND
	3/3/2010	ND	ND	ND	ND
	8/30/2010	3.6	**5.1**	**18**	ND
	3/15/2011	2.8	**6.7**	**22**	ND
	8/10/2011	ND	ND	**ND**	ND
UNW-107	8/3/1998	ND	ND	3	ND
	8/26/2004	4.7	ND	3.6	ND
	8/21/2006	3.4	**14**	2	1.2
	3/13/2007	25	2[c]	**23**	2[b]
	8/21/2007	17	ND	**30**	0.3[c]
	3/5/2008	ND	ND	ND	ND
	8/18/2008	ND	ND	ND	ND
	3/12/2009	ND	ND	ND	ND
	7/30/2009	ND	ND	ND	ND
	3/4/2010	ND	ND	ND	ND
	7/28/2010	ND	ND	ND	ND
	3/16/2011	ND	ND	ND	ND
	8/11/2011	ND	ND	ND	ND

[a]Bold table entries exceed primary drinking water MCL screening values (PCE, TCE = 5 μg/L, cis-1,2-DCE = 70 μg/L, vinyl chloride = 2 μg/L).

[b]Detection occurred in a field replicate. Constituent not detected in regular sample.

[c]Estimated value.

Abbreviations

BRW = bedrock well
DCE = dichloroethene
ND = not detected
PCE = tetrachloroethene
TCE = trichloroethene
UNW = unconsolidated well

Wells BRW-003 and BRW-017 (Fig. 3.51) monitor groundwater at the K-1064 Peninsula burn area. Figure 3.51 shows the history of VOC concentrations in groundwater from FY 1994 through FY 2011. TCE concentrations have declined in both wells, and TCE was detected at concentrations slightly below MCL in well BRW-017 during FY 2011. Both 1,1,1-TCA and cis-1,2-DCE have declined to undetectable concentrations in well BRW-003. Cis-1,2-DCE was detected in both FY 2011 quarterly samples in well BRW-017.

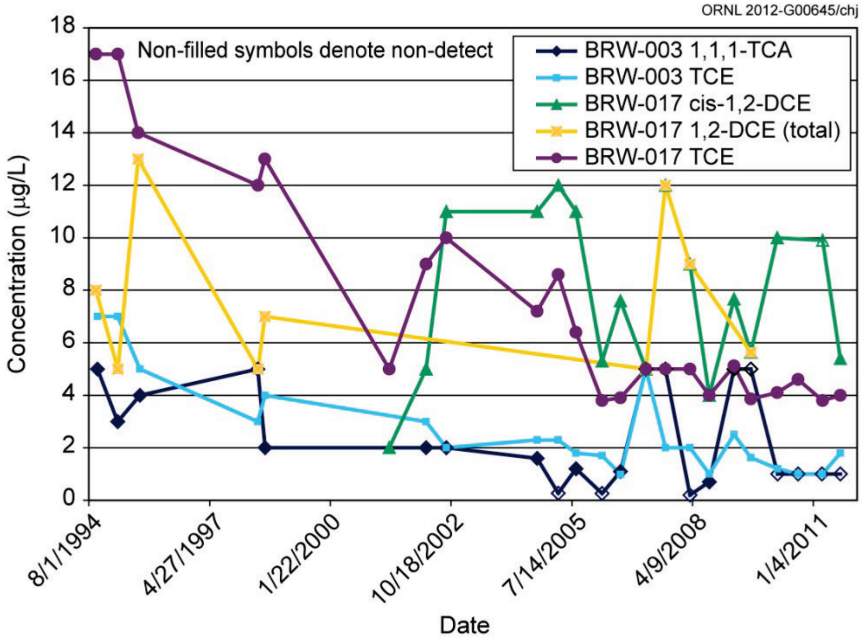


Fig. 3.51. Volatile organic compound concentrations in groundwater at K-1064 Peninsula area.

Groundwater is monitored in four wells that lie between buildings K-31 and K-33 and Poplar Creek (BRW-066, BRW-030, UNW-080, and UNW-043). VOCs are not COCs in this area; however, leaks of recirculated cooling water in the past have left residual subsurface chromium contamination. Figure 3.52 shows the history of chromium detection in wells at K-31–K-33. Well UNW-043 exhibits the highest residual chromium concentrations of any in the area. Chromium concentrations in well UNW-043 correlate with the turbidity of samples, and acidification of unfiltered samples that contain suspended solids often causes detection of high metals content because the acid preservative dissolves metals that are adsorbed to the solid particles at the normal groundwater pH. During FY 2006, an investigation was conducted to determine whether groundwater in the vicinity of the K-31–K-33 buildings contained residual hexavalent chromium from recirculated cooling water leaks. The data indicated the chromium in groundwater near the leak sites was essentially all the less toxic trivalent species. During FY 2008 through FY 2011, field-filtered (i.e., dissolved) and unfiltered samples were collected from UNW-043. Chromium concentrations in the FY 2011 unfiltered samples decreased significantly but were still higher than those for their filtered counterparts. During FY 2011 both field filtered and unfiltered samples were collected from wells BRW-066, UNW-043, and UNW-080. Chromium was “non-detect” in all samples from well BRW-066. With the exception of the Q4 samples from well UNW-080, in which the filtered sample had only slightly lower chromium than the unfiltered sample, for FY 2011 all filtered samples contained much less chromium than their unfiltered counterparts.

Several exit pathway wells are monitored in the K-27–K-29 area. Figure 3.53 provides concentrations of detected VOCs in wells both north and south of K-27 and K-29 through FY 2011. The source of VOC contamination in well BRW-058 is not suspected to be from K-27–K-29 area operations. VOC concentrations in this area show very slowly declining concentrations, with the exception of cis-1,2-DCE in well BRW-058, which appears stable to slightly increasing.

Wells BRW-084 and UNW-108 are exit pathway monitoring locations at the northern edge of the K-1007-P1 pond (see Fig. 3.49). These wells were monitored intermittently from 1994 through 1998 and semiannually from FY 2001 through FY 2011. The first detections of VOCs in these wells occurred during FY 2006 with detection of low concentrations of TCE and cis-1,2-DCE (~10 µg/L or less). The source area for these VOCs is not known. VOCs were not detected in either of these wells during FY 2011. Metals were detected and associated with the presence of high turbidity in the samples. Manganese exceeded the secondary drinking water standard in the filtered sample from UNW-108 in the

2011 Q4 sampling event. No other primary or secondary MCLs for metals were exceeded in sample aliquots that were field-filtered before acid preservation during FY 2011.

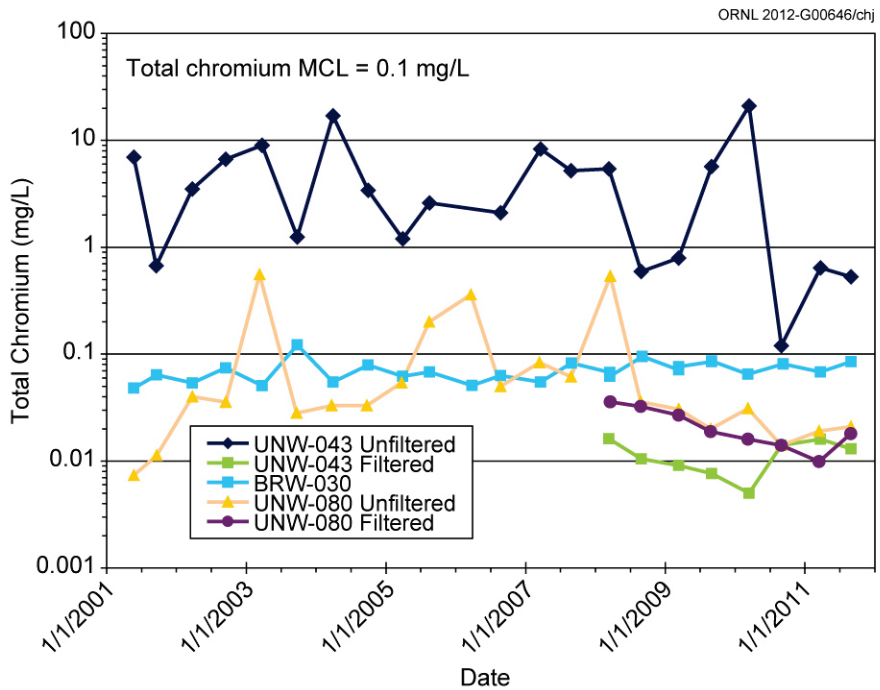


Fig. 3.52. Chromium concentrations in groundwater in the K-31–K-33 area.

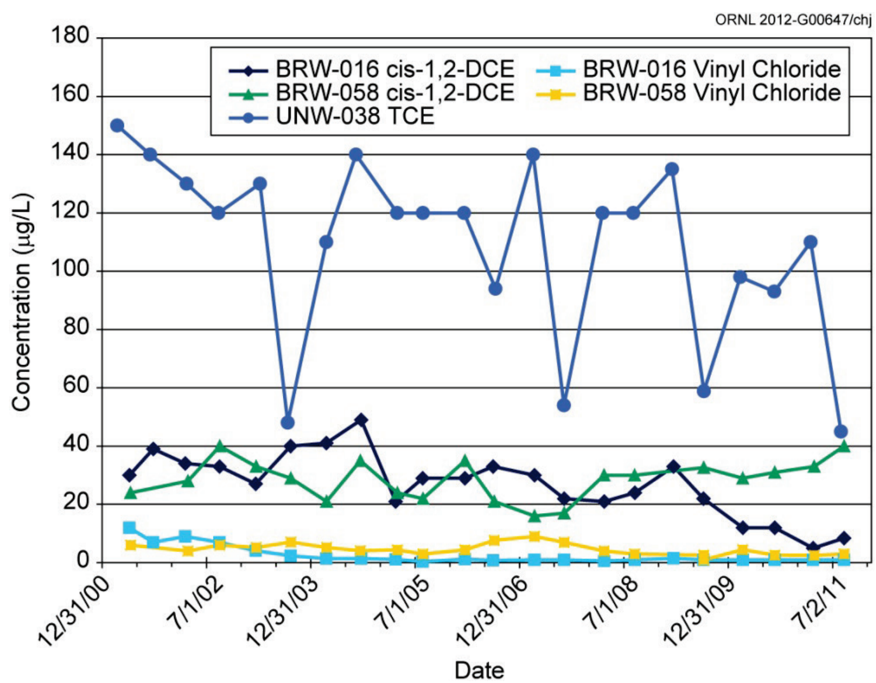


Fig. 3.53. Detected volatile organic compound concentrations in groundwater exit pathway wells near K-27 and K-29.

Exit pathway groundwater in the K-901-A holding pond area (Fig. 3.49) is monitored by four wells (BRW-035, BRW-068, UNW-066, and UNW-067) and two springs [21-002 and Poplar Creek Orange (PCO)]. Very low concentrations (<5 µg/L) of VOCs are occasionally detected in wells adjacent to the K-901-A holding pond. However, these contaminants are not persistent in groundwater west and south of the pond. The only VOC detected in the K-901-A pond exit pathway wells during FY 2011 was chloroform in the Q4 sample of well BRW-068. Alpha and beta activity levels were less than 15 pCi/L and 25 pCi/L, respectively, at all wells. TCE is the most significant groundwater contaminant detected in the springs, and the historic TCE concentrations are shown in Fig. 3.54. PCO was added to the sampling program in 2004. During the spring through autumn seasons, PCO is submerged beneath Watts Bar Lake, so this location is accessible for sampling only during winter when the lake level is lowered by TVA. The contaminant source for PCO is presumed to be disposed waste at the K-1070-F site. The TCE concentrations were above MCL but had shown a decreasing trend until FY 2011, when they increased. In addition to TCE, uranium isotopes and gross beta activity (at an estimated value) were reported at low levels in FY 2011. At spring 21-002, 1,1,1-TCA, 1,2-DCE, carbon tetrachloride, and PCE are sometimes present at concentrations typically less than 5 μg/L. The TCE concentration at spring 21-002 tends to vary between 5 and about 25 μg/L. The variation of concentration appears to be related to variability in rainfall, which affects groundwater discharge from the K-1070-A VOC plume. During FY 2011, TCE was detected above the 5 μg/L MCL in both quarterly samples. In addition, low levels of alpha and beta activity were detected, as was ^{99}Tc, in the Q4 sample.

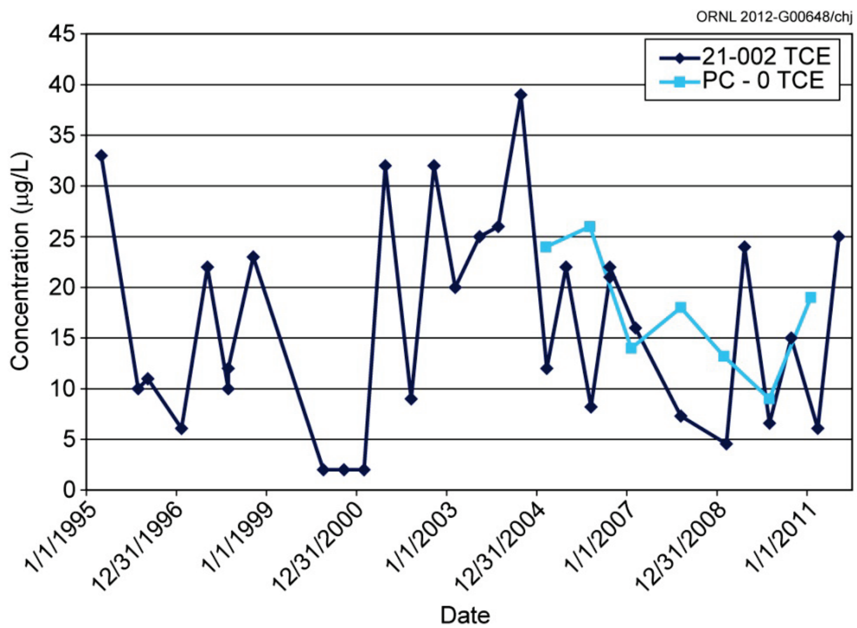


Fig. 3.54. Historic trichloroethene concentrations in K-901 area springs.

Exit pathway groundwater monitoring is also conducted at the K-770 area, where wells UNW-013 and UNW-015 are used to assess radiological groundwater contamination along the Clinch River. Well UNW-015 could not be sampled in FY 2011 because of construction activities. Beta activity was detected at 35.1 and 60.7 pCi/L for Q2 and Q4, respectively, in well UNW-013. Figure 3.55 shows the history of measured alpha and beta activity in this area. Analytical results indicate that the alpha activity is largely attributable to uranium isotopes, and well UNW-013 historically contained ^{99}Tc, which is a strong beta-emitting radionuclide responsible for the elevated beta activity in that well. The alpha and beta activity levels in the area groundwater exhibit stable but variable conditions.

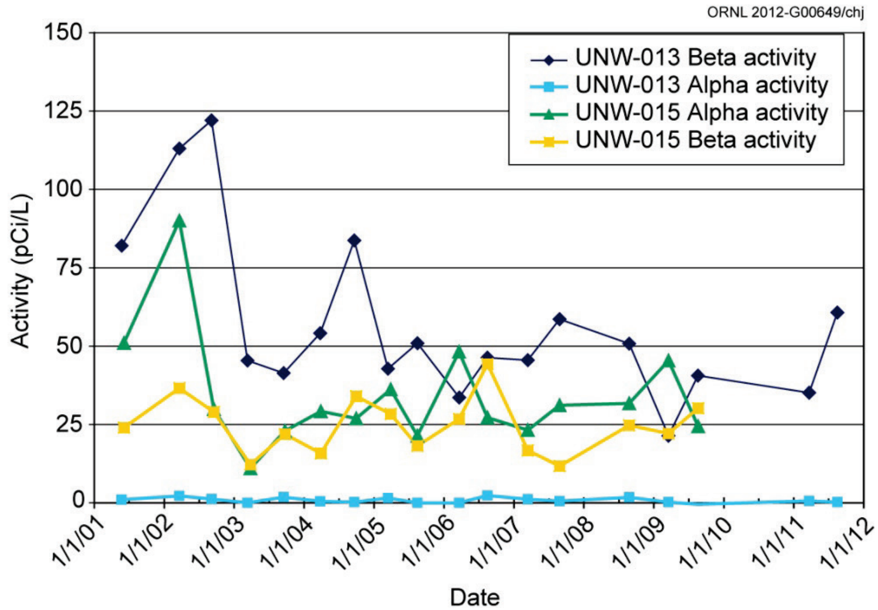


Fig. 3.55. History of measured alpha and beta activity in the K-770 area.

3.5.4.5 Groundwater Sampling Adjacent to Potential Source Areas

Additional monitoring of groundwater adjacent to potential sources of groundwater contamination, including the K-1070-C/D burial ground, was conducted to monitor trends (DOE 2005). Monitoring will continue until a final Zone 2 ROD is approved.

Monitoring locations, analytical parameters, and cleanup levels were not specified for groundwater monitoring at the K-1070-C/D burial ground (Fig. 3.56), although the primary COCs in that area are VOCs. Semiannual samples are analyzed for VOCs and general water quality parameters in several wells and surface water locations outside the perimeter of the K-1070-C/D burial ground. Monitoring at the site is focused on providing data for evaluating changes in contaminant concentrations near the source units or potentially discharging to surface water within the boundaries of the ETTP.

Monitoring wells UNW-114, TMW-011, and UNW-064 (Fig. 3.56) monitor the VOC plume leaving the K-1070-C/D burial ground. Results of monitoring at these wells show elevated VOC concentrations. VOC concentrations at these three wells were decreasing before the excavation of the G-Pit contents (during FY 2000) that were the source of this plume. VOC concentrations continued to decrease through 2005, when concentrations stabilized. Concentrations at wells UNW-064 (Fig. 3.57) and UNW-114 (Fig. 3.58) increased slightly during FY 2009 and FY 2010 in response to the above average rainfall that occurred during those years. The primary VOC detected in well UNW-114, near the K-1070-C/D burial ground, during FY 2011 was 1,1-DCA at 290–400 µg/L. Anaerobic biodegradation of PCE and TCE or hydrolysis of 1,1,1-TCA can produce 1,1-DCA. Significant concentrations of 1,1-DCA were detected in wells TMW-011 (Fig. 3.59) (330–550 µg/L) and UNW-064 (120–160 µg/L). Other VOCs detected in concentrations ≥85 µg/L were 1,1-DCE (150–370 µg/L) and TCE (120 µg/L) at TMW-011, TCE at UNW-114 (110 µg/L and chloroethane (110 µg/L) at UNW-064. MCLs were exceeded for 1,1-DCE (7 µg/L), TCE (5 µg/L), and vinyl chloride (2 µg/L) at all three wells. The PCE concentration in wells TMW-011 and UNW-114 exceeded MCL (5 µg/L) and the cis-1,2 DCE concentration in well TMW-011 increased to 97 µg/L, above MCL (70 µg/L). Slight increases in concentrations of several VOCs were observed during FY 2011, presumably as a result of the fluctuations in rainfall.

Since removal of soil and debris from the K-1070-C/D burial ground in 1999 the concentrations of VOCs in groundwater have decreased downgradient of the removal area. An evaluation of VOC concentrations in wells UNW-064 and TMW-011 over the past several years indicates that VOC concentrations in groundwater have declined and remain relatively stable with fluctuations related to climatic cycles. In FY 2011, 1,1-DCA and TCE increased noticeably in well UNW-114. Increases in some VOC concentrations resulting in MCL exceedances were observed in FY 2011 likely due to fluctuations in precipitation.

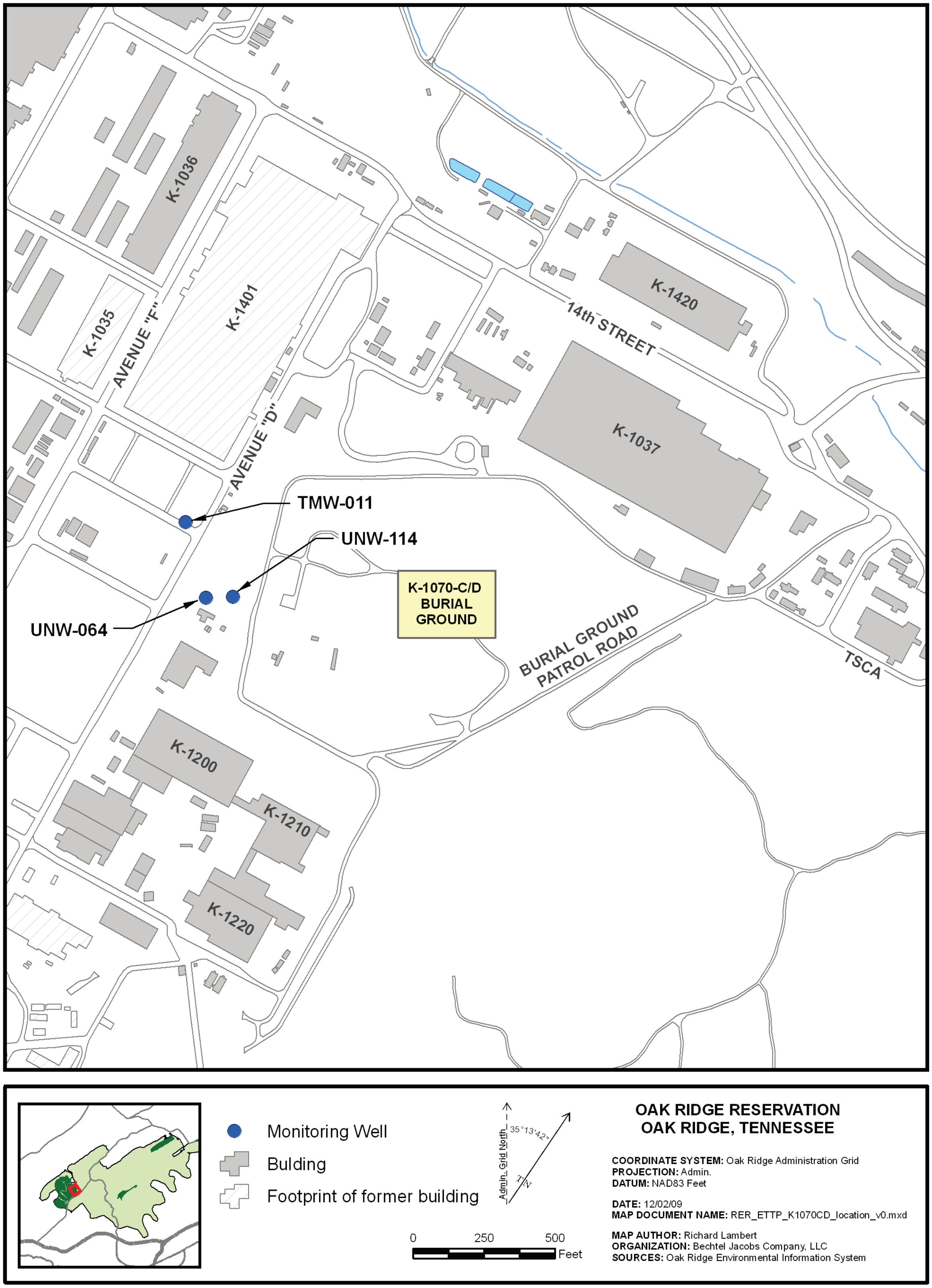


Fig. 3.56. Groundwater monitoring locations for the K-1070-C/D burial ground.

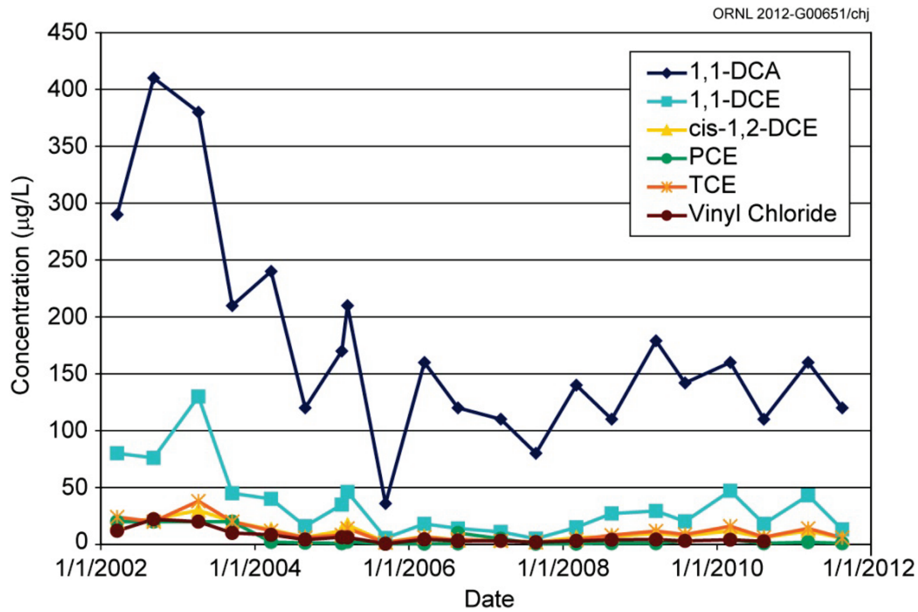


Fig. 3.57. Volatile organic compound concentrations in well UNW-064 for FY 2002 through FY 2011.

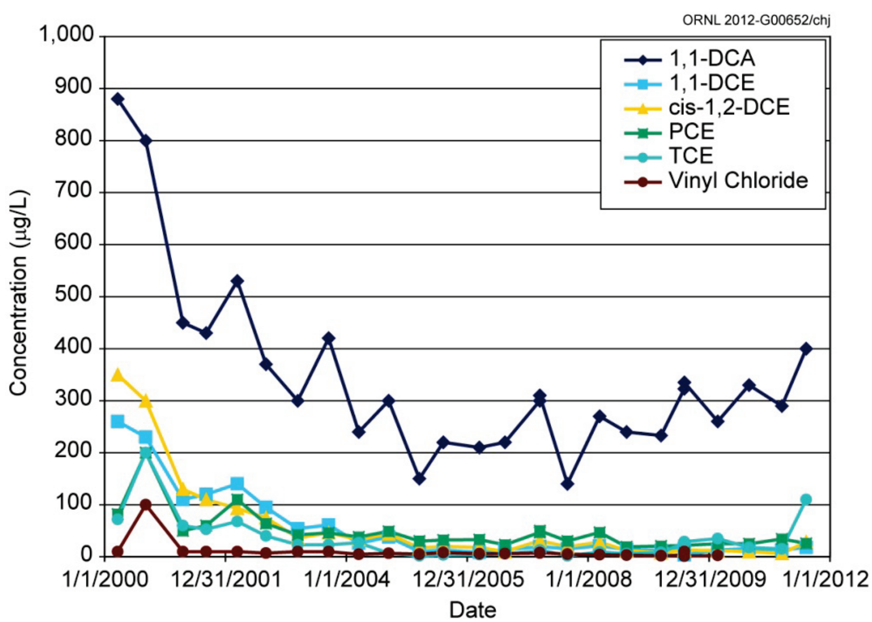


Fig. 3.58. Volatile organic compound concentrations in well UNW-114 for FY 2000 through FY 2011.

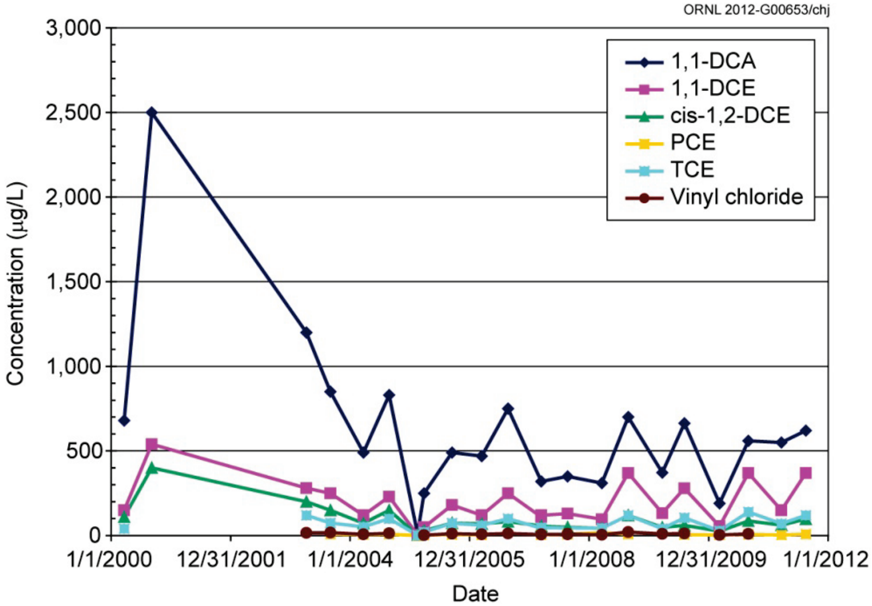


Fig. 3.59. Volatile organic compound concentrations in well TMW-011 for FY 2000 through FY 2011.

3.5.4.6 Groundwater Sampling in the K-1407-B and C ponds area at East Tennessee Technology Park

The *Remedial Action Report for the K-1407-B Holding Pond and the K-1407-C Retention Basin* (DOE 1995a) proposes semiannual groundwater monitoring for nitrate, metals, and selected radionuclides, including gross alpha and beta activity, ^{99}Tc, ^{90}Sr, ^{137}Cs, ^{230,232}Th, and ^{234,238}U. However, VOCs are the primary groundwater contaminant in the Mitchell Branch area of ETTP. Remediation target concentrations were not established in the CERCLA decision documents for use in post-remediation monitoring. As recommended by EPA, with concurrence from TDEC, performance monitoring is conducted in wells UNW-003, UNW-009, and the Mitchell Branch weir (K-1700 Weir), shown on Fig. 3.60.

The primary groundwater contaminants in the K-1407-B and -C ponds area of ETTP are VOCs, which are widespread in this portion of the plant, including contaminant sources upgradient of the ponds. Groundwater samples were collected at UNW-003 and UNW-009 in March and August 2011. Monitoring results for FY 2011 at wells are consistent with results from previous years. Gross alpha activity was detected at 4.96 pCi/L in March and at 3.54 pCi/L in August at UNW-003 and was not detected at UNW-009 in March or August. Gross beta activity ranged from 11.6 to 22.5 pCi/L at UNW-003. Gross beta activity was not detected in March but was detected in August at 4.19 pCi/L at UNW-009. The radionuclide ^{99}Tc was detected at 20.5 pCi/L in August at UNW-003. Uranium-234 was not detected at UNW-009 but was detected at 4.13 pCi/L in March and 2.18 pCi/L in August at UNW-003. None of the metals exceeded the primary drinking water standards. Iron was elevated above the secondary drinking water standard in all but one of the unfiltered sample aliquots. Only the field-filtered samples for iron from UNW-003 were below the secondary standard. The secondary standard for aluminum was not exceeded in any samples. Manganese exceeded the secondary drinking water standard in both filtered and unfiltered aliquots from both wells during both sampling events. The elevated manganese levels are likely caused by chemical reduction in the local groundwater induced by reductive dehalogenation of VOCs.

High concentrations of several VOCs are present in groundwater in well UNW-003 downgradient of the former K-1407-B pond and adjacent to Mitchell Branch. Significant concentrations of PCE (170–1,000 µg/L) and TCE (1,500–5,900 µg/L) and the degradation products 1,1-DCE (230–1,100 µg/L), 1,1-DCA (310–1,000 µg/L), cis-1,2-DCE (920–2,600 µg/L), and vinyl chloride (120 µg/L) were detected at UNW-003 in FY 2011. The detection of VOCs at concentrations well above 1,000 µg/L and the steady concentrations over recent years strongly suggest the presence of dense nonaqueous phase liquids

(DNAPLs) in the vicinity of this well. The Zone 2 final ROD will address groundwater contamination present in the area of the former ponds.

Fig. 3.60. Location of K-1407-B and -C ponds.

3.5.4.7 Groundwater Sampling Summary

During FY 2011, monitoring results for the principal groundwater locations indicated that contaminant levels are generally stable to decreasing in most instances. Collection and treatment of groundwater containing hexavalent chromium is ongoing and is protective of water quality in Mitchell Branch. Mercury detections at storm drain outfalls and the K-1700 Weir indicate the need for additional investigation to identify potential mercury sources.

Contaminants detected during previous years in exit pathway groundwater near the K-1007-P1 weir were not detected in FY 2011. Concentrations of PCE and TCE greater than MCL were detected in a bedrock well in the exit pathway located at the mouth of Mitchell Branch and TCE greater than MCL at well BRW-058. TCE also exceeded MCL in the single sample from PCO. These contaminant levels are similar to those seen in FY 2010. Manganese exceeded the secondary drinking water standard in one filtered sample. Most of the groundwater plume monitoring results indicate stable contaminant levels compared to recent years.

3.6 Biological Monitoring

The ETTP BMAP consists of three tasks designed to evaluate the effects of ETTP operations on the local environment, identify areas where abatement measures would be most effective, and test the efficacy of the measures. These tasks are (1) toxicity monitoring of effluent and ambient waters from several locations within Mitchell Branch, (2) bioaccumulation studies, and (3) instream monitoring of biological communities. Figure 3.61 shows the major water bodies at ETTP, and Fig. 3.62 shows the BMAP monitoring locations along Mitchell Branch.

In spring (April) and fall (October to November) of 2011, survival and reproduction toxicity tests using the water flea *Ceriodaphnia dubia* (Fig. 3.63) were conducted at five ambient locations in Mitchell Branch. At the same time, survival and reproduction toxicity tests using *C. dubia* were conducted on effluent from storm water Outfalls 170 and 190. In both spring and fall tests (Table 3.23), none of the water from the ambient station or from storm water Outfall 190 exhibited toxicity. In both the spring and fall tests, full strength effluent from storm water Outfall 170 reduced reproduction but did not affect survival.

In 2011 caged clams *(Corbicula fluminea)* were placed at several locations around ETTP (Table 3.24). The clams (Fig. 3.64) were allowed to remain in place for 4 weeks and were then analyzed for PCBs and total mercury and methylmercury. The spatial patterns of PCB concentrations in clams were generally consistent with those of previous years, although the concentration of PCBs in clams from MIK 0.2 and MIK 0.27 increased substantially from the 2010 monitoring. While the concentrations in PCBs from clams from the K-1007-P1 pond and storm water Outfall 100 remain the highest of any on ETTP and increased slightly from last year, the overall trend in the last several years has been of decreasing concentrations. Concentrations of PCBs in clams from the K-901-A pond increased slightly from the levels of 2010, but the levels remained considerably lower than those found in and around the K-1007-P1 pond. While three Aroclors (Aroclor 1248, 1254, and 1260) were detected in clams from the K-1007-P1 pond and the K-901-A pond, the primary Aroclor detected in clams from Mitchell Branch was Aroclor 1254.

Clams from the Mitchell Branch watershed were analyzed for mercury (both total mercury and methyl mercury) in 2011 (Table 3.24). Although mercury was detected in all clams, the highest mercury concentrations were found in the clams from the section between MIK 0.2 and MIK 0.5, with concentrations of total mercury in the clams ranging from 81 ng/g to 188 ng/g. Results from the 2011 monitoring were significantly higher than those of the previous years' monitoring at the same locations. Methyl mercury concentrations in clams from Mitchell Branch ranged from 10% to 40% of the total mercury concentration at all locations.

Bioaccumulation monitoring in the K-1007-P1 pond, K-901-A pond, K-720 slough, and Mitchell Branch involves sampling of fish (Fig 3.65) and analyzing the tissues for PCB concentrations (Table 3.25). Typically, fillets of game fish are used as a monitoring tool to assess human health risks, while whole body composites of forage fish are used to assess ecological risks associated with exposure to PCBs. The target species for bioaccumulation monitoring in 2011 in the K1007-P1 pond was bluegill sunfish (*Lepomis macrochirus*) (Fig. 3.66).

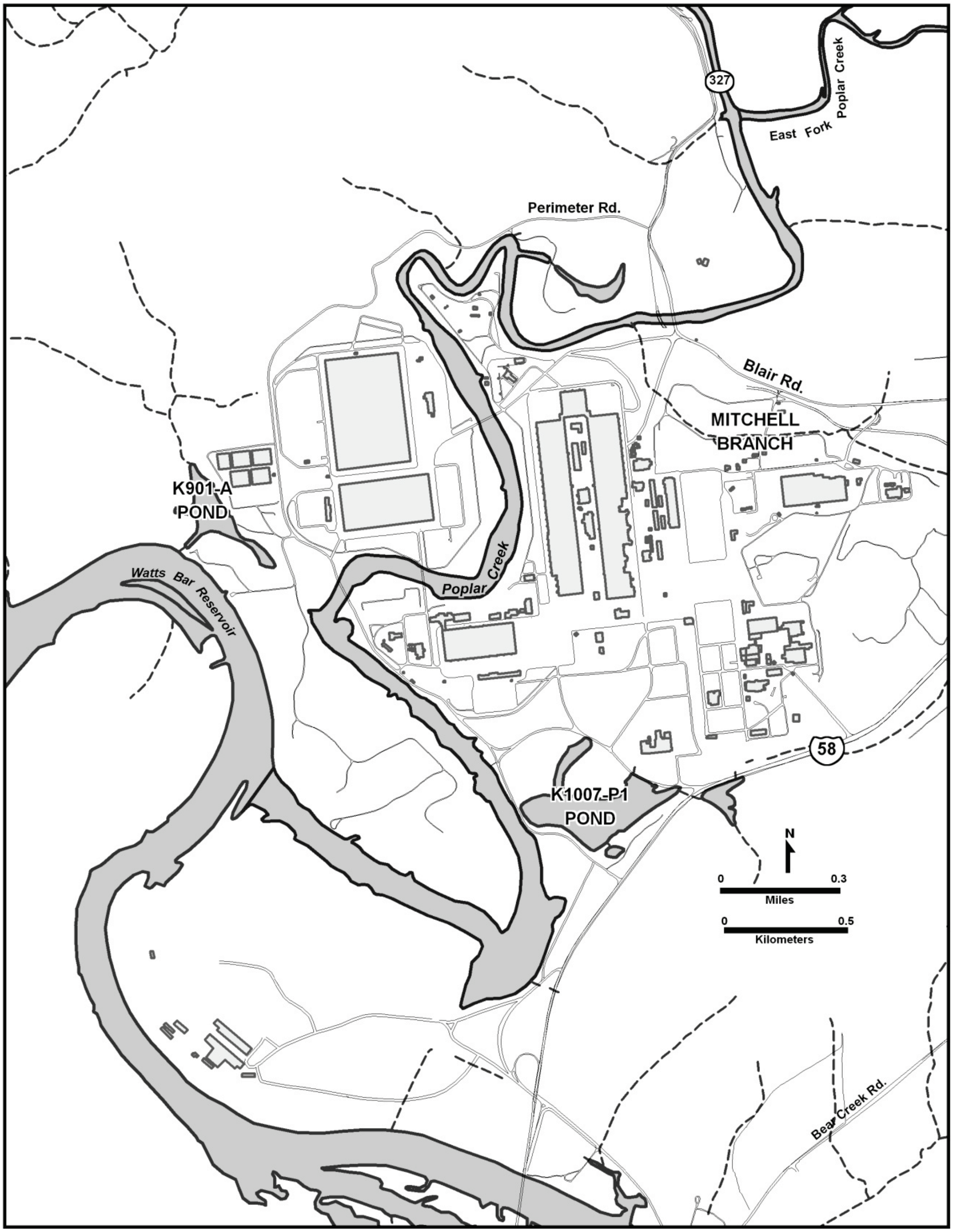


Fig. 3.61. Water bodies at the East Tennessee Technology Park.

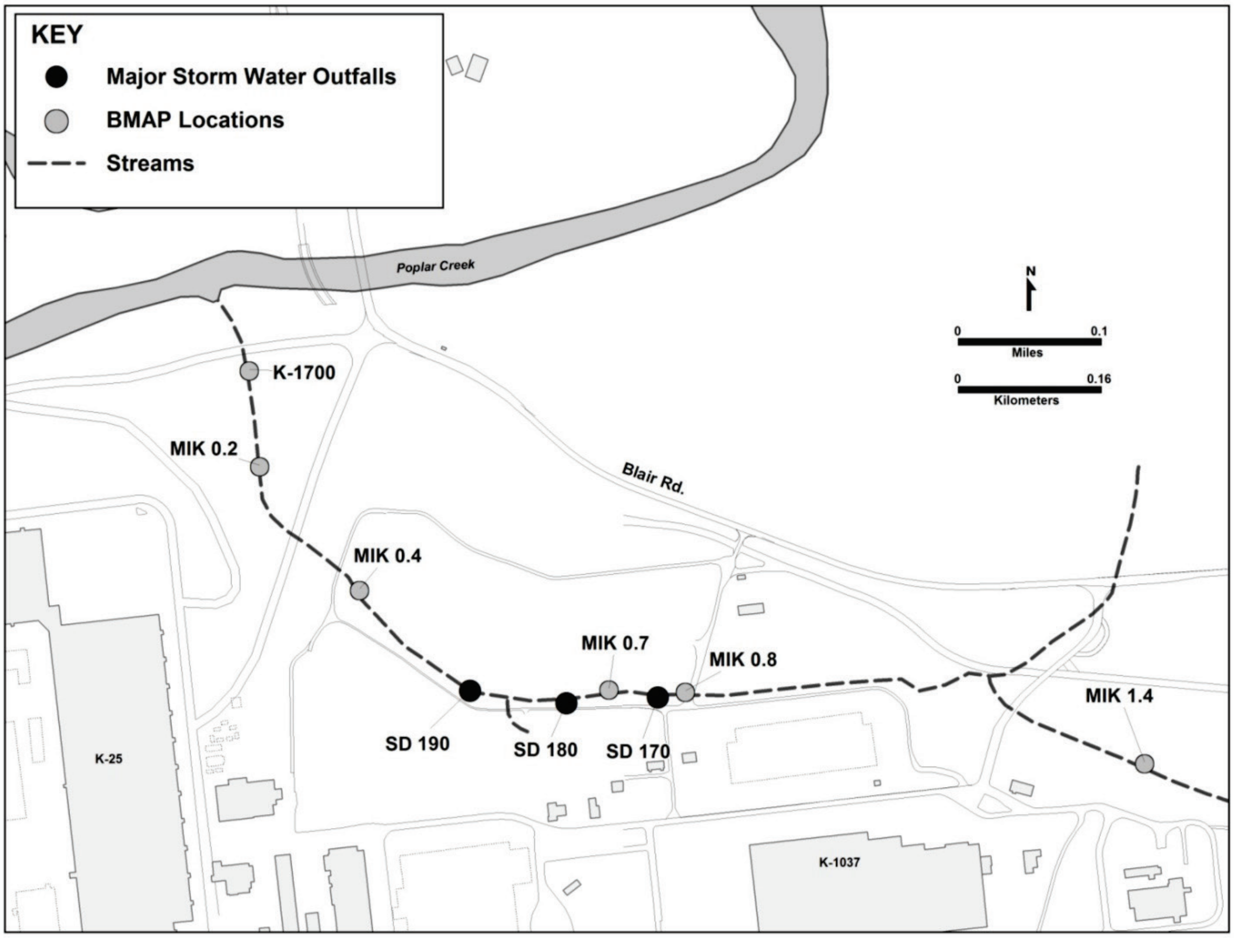


Fig. 3.62. Major storm water outfalls and biological monitoring locations on Mitchell Branch.

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Fig. 3.63. Water flea *(Ceriodaphnia dubia)*.

Table 3.23. Mitchell Branch and associated storm water outfall toxicity test results, 2011 (no-observed-effects concentrations)[a]

Season	Test	MIK 1.4	MIK 0.8	SD 170	MIK 0.7	SD 190	MIK 0.4	MIK 0.2
Spring	*Ceriodaphnia dubia* survival (%)	100	100	100	100	100	100	100
	C. dubia reproduction (%)	100	100	50	100	100	100	100
Fall	*C. dubia* survival (%)	100	100	100	100	100	100	100
	C. dubia reproduction (%)	100	100	50	100	100	100	100

[a]Highest tested concentrations of effluent or stream water which had no effect on either survival or reproduction of *C. dubia* in three-brood static renewal tests (EPA test method 1002.0).

Abbreviations

MIK = Mitchell Branch kilometer SD = storm water outfall

Table 3.24. Analytical results and locations of caged clams in June and July 2011[a]

Site	Sample ID	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total Aroclors	Total Hg	MeHg
			Reference Site				
Sewee Creek	17593A	ND	0.003	0.002	0.005	19.60	11.85
	17593B	ND	0.003	0.002	0.005	27.20	12.00
			Mitchell Branch				
MIK 0.8 (above SD 170)	17587A	ND	0.10	0.01	0.11	37.00	12.69
	17587B	ND	0.14	0.01	0.15	46.90	16.61
SD170	17588A	ND	0.14	0.02	0.16	67.20	9.76
	17588B	ND	0.14	0.02	0.16	80.70	14.94
MIK 0.7 (below SD170)	17589A	ND	0.12	0.01	0.13	37.70	14.75
	17589B	ND	0.15	0.02	0.17	64.80	19.83
MIK 0.5 (below SD 180)	17590A	ND	0.12	0.01	0.13	97.20	14.08
	17590B	ND	0.14	0.02	0.16	154.80	21.74
SD190	17591A	ND	1.90	0.46	2.36	109.90	21.66
	17591B	ND	1.40	0.30	1.70	80.70	17.39
MIK 0.4 (below SD190)	17592A	ND	1.40	0.31	1.71	114.00	22.16
	17592B	ND	1.50	0.32	1.82	102.30	26.80
MIK 0.3	17586A	3.30	3.20	0.24	6.74		
	17586B	2.00	2.40	0.16	4.56		

Table 3.24. (continued)

Site	Sample ID	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total Aroclors	Total Hg	MeHg
MIK 0.27	17585A	2.20	2.10	0.12	4.42		
	17585B	2.40	2.40	0.14	4.94		
MIK 0.2	17584A	2.40	2.70	0.23	5.33	166.30	23.39
	17584B	2.20	2.40	0.22	4.82	187.90	23.09
K1007-P1 Pond							
SD 100 (upper)	17579A	1.40	0.80	0.05	2.25		
	17579B	1.10	0.61	0.04	1.75		
SD 100 (lower)	17580A	3.40	2.00	0.55	5.95		
	17580B	2.50	1.60	0.40	4.50		
SD 120	17581A	0.34	0.37	0.04	0.75		
	17581B	0.44	0.48	0.05	0.97		
SD 490	17578A	0.11	0.21	0.07	0.39		
	17578B	0.14	0.25	0.07	0.46		
P1	17582A	0.83	0.49	0.06	1.38	23.00	6.54
	17582B	1.10	0.51	0.07	1.68	22.60	12.96
K901A Pond							
K901A outfall	17583A	0.08	0.15	0.07	0.30	33.10	11.13
	17583B	0.06	0.10	0.05	0.20	46.40	7.52

[a]PCBs (shown as Aroclors 1248, 1254, 1260, and total Aroclors; µg/g) and total mercury and methyl mercury (ng/g) in caged Asiatic clams (*Corbicula fluminea*) placed near storm drains and pond outfalls for 4-week periods, June and July 2011. Results are reported on a wet weight basis for composite samples (of 10 clams) from each basket.

Abbreviations

ID = identification (number)
SD = storm water outfall
MIK = Mitchell Branch kilometer

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Fig. 3.64. Asiatic clam (*Corbicula fluminea*).

ORNL 2010-G00935/chj

Fig. 3.65. Fish bioaccumulation sampling at K-1007-P1 pond.

Table 3.25. Average PCB concentrations in fish, 2011[a]

Site	Species	Sample type	Sample size (n)[b]	Total PCBs (mean ± SE)	Range of PCB values	No. > 1 ppm (PCBs)/N	Total Hg (mean ± SE)
K-1007-P1	Bluegill sunfish	Fillet	20	1.85 ± 0.31	0.47 – 5.56	14/20	
	Bluegill sunfish	Whole body composites	6	5.62 ± 0.48	4.86 – 7.93	6/6	
K-901-A pond	Largemouth bass	Fillet	10	0.50 ± 0.08	0.28 – 1.00	1/10	
	Common carp	Fillet	10	2.06 ± 0.25	1.20 – 3.86	10/10	
	Gizzard shad	Whole body composites	6	5.57 ± 0.13	5.13 – 6.03	6/6	
K-720 slough	Largemouth bass	Fillet	3	0.24 ± 0.02	0.20 – 0.26	0/3	
	Common carp	Fillet	4	0.96 ± 0.21	0.63 – 1.58	1/4	
	Smallmouth buffalo	Fillet	13	0.77 ± 0.19	0.05 – 2.57	5/13	
	Gizzard shad	Whole body composites	6	0.26 ± 0.03	0.18 – 0.34	0/6	
Mitchell Branch	Redbreast sunfish	Fillet	6	1.12 ± 0.21	0.48 – 1.96	3/6	0.34 ± 0.04
Hinds Creek	Redbreast sunfish	Fillet	5	0.06 ± 0.001	0.057 – 0.060	0/6	0.07 ± 0.01

[a]Total PCB (Aroclors 1248, 1254, and 1260) concentrations in fish from the K-1007-P1 pond, the K-901 pond, the K-720 slough, Mitchell Branch, and the reference site, Hinds Creek, 2011. Values are mean concentrations (µg/g) ± 1 standard error (SE). Each whole body composite sample comprises 10 individual fish. Where available, data for mean total mercury concentrations (µg/g) are shown.

[b]N = Number of individuals in the sample.

Abbreviations

PCB = polychlorinated biphenyl

ORNL 2011-G00782/chj

Fig. 3.66. Bluegill sunfish (*Lepomis macrochirus*).

Whole body composites (six composites of 10 bluegill per composite) and fillets from 20 individual bluegill were analyzed for PCBs to assess the ecological and human health risks associated with PCB contamination in this pond. Average PCB levels in whole body composites were 5.62 µg/g, as shown in Table 3.25. Fillets averaged 1.85 µg/g total PCBs, comparable to levels seen in 2010 (2.13 µg/g). Average PCB concentrations in sunfish collected in Mitchell Branch were 1.12 µg/g, similar to the levels seen in 2010 (1.2 µg/g). These levels are higher than the concentrations observed in fillets of largemouth bass from the K901A pond (~ 0.5 µg/g). In addition to being analyzed for PCBs, the sunfish collected from Mitchell Branch (MIK 0.2) were analyzed for total mercury. Previous studies have shown that methyl mercury accounts for more than 95% of the total mercury in fish, so a separate analysis for methyl mercury was not conducted. The EPA's recommended limit for mercury in fish fillets is 0.3 µg/g. Levels of mercury in fish collected at MIK 0.2 were 0.34 µg/g, slightly exceeding this limit and roughly unchanged from last year (0.38 µg/g).

In April 2011, the benthic macroinvertebrate community at four Mitchell Branch locations (MIKs 0.4, 0.7, 0.8, and 1.4) was sampled by the ORNL Environmental Sciences Division using standard quantitative techniques. MIK 1.4 was the reference location. Over the last several years, the condition of the benthic macroinvertebrate community at all locations in Mitchell Branch has generally improved, but the rate of improvement has slowed in recent years. In 2011, the results of monitoring at MIK 0.4 show that the benthic community at that location continues to be negatively impacted. However results for MIKs 0.7 and 0.8 suggest that conditions are becoming more similar to those of the reference site at MIK 1.4. In 2011, total taxa richness and richness of the *Ephemeroptera, Plecoptera*, and *Trichoptera* (EPT) species was greatest at MIK 1.4 and decreased at the downstream locations (Fig. 3.67). EPT species are generally pollution intolerant, and lower numbers generally correlate to some degree of impact to the stream. Total density at MIKs 0.4, 0.7 and 0.8 was greater than at MIK 1.4, but the density of pollution-intolerant species was generally lower at all of the locations downstream of MIK 1.4.

Since August 2008, TDEC protocols, which assess both community and habitat characteristics, have also been used at the MIK 0.4, 0.7, and 0.8 monitoring locations. Beginning in August 2009, the use of TDEC protocols was expanded to include MIK 1.4 as well (Fig. 3.68). In 2011, the biotic index (Fig. 3.69) indicates that the community at MIK 0.4 was moderately impaired and the community at MIK 0.8 was slightly impaired. The habitat assessment (which primarily considers the physical aspects of the stream to determine its suitability to support biological communities) indicated that not all sampling locations along Mitchell Branch met the habitat goals for this region. In 2011, habitat at MIKs 0.7 and 0.8 met the habitat goals, while MIKs 0.4 and1.4 scored as being moderately impaired. Overall, the results from semiquantitative (TDEC protocols) and quantitative (ORNL protocols) macroinvertebrate assessments were in general agreement that MIK 0.4 is moderately to severely impaired and that slight impairment remains at MIKs 0.7 and 0.8. This indicates that the improvements observed in recent years at MIK 0.7 and MIK 0.8 are persisting, while the negative change in the community at MIK 0.4 observed after 2005 continues to persist.

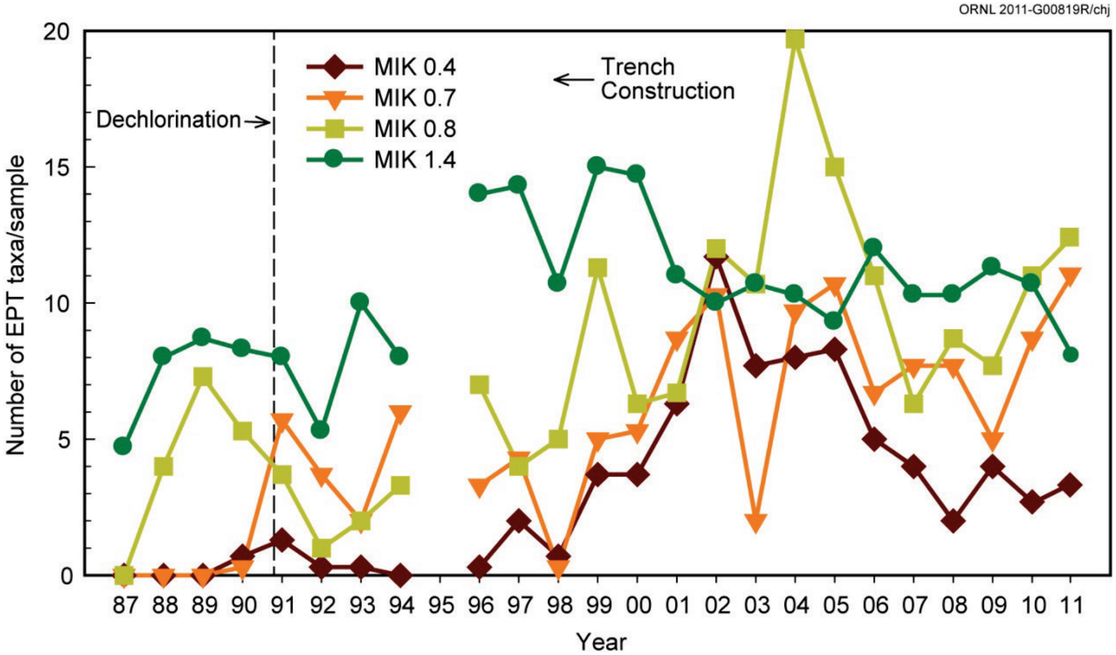

Fig. 3.67. Mean taxonomic richness of the pollution-intolerant *Ephemeroptera, Plecoptera,* and *Trichoptera* (mayflies, stoneflies, and caddisflies or EPT) taxa per sample for the benthic macroinvertebrate community in Mitchell Branch, 1987–2011. Samples were not collected in April 1995, as indicated by the gap in the lines. MIK = Mitchell Branch kilometer.

Fig. 3.68. Benthic macroinvertebrate sampling using Tennessee Department of Environment and Conservation protocols.

Fish communities in Mitchell Branch (MIKs 0.4 and 0.7) and at a local reference site were sampled in 2011 (Table 3.26). Species richness, density, and biomass were examined. Results for 2011 indicate an increase in biomass and density from last year, while species richness remained only slightly improved. Variations in these three parameters are typical of streams that have been severely impacted and are still recovering. While the condition of the fish communities over the last several years has been relatively stable, they have yet to reach conditions typical of less impacted streams in the area, and the stream is still dominated by more tolerant fish species.

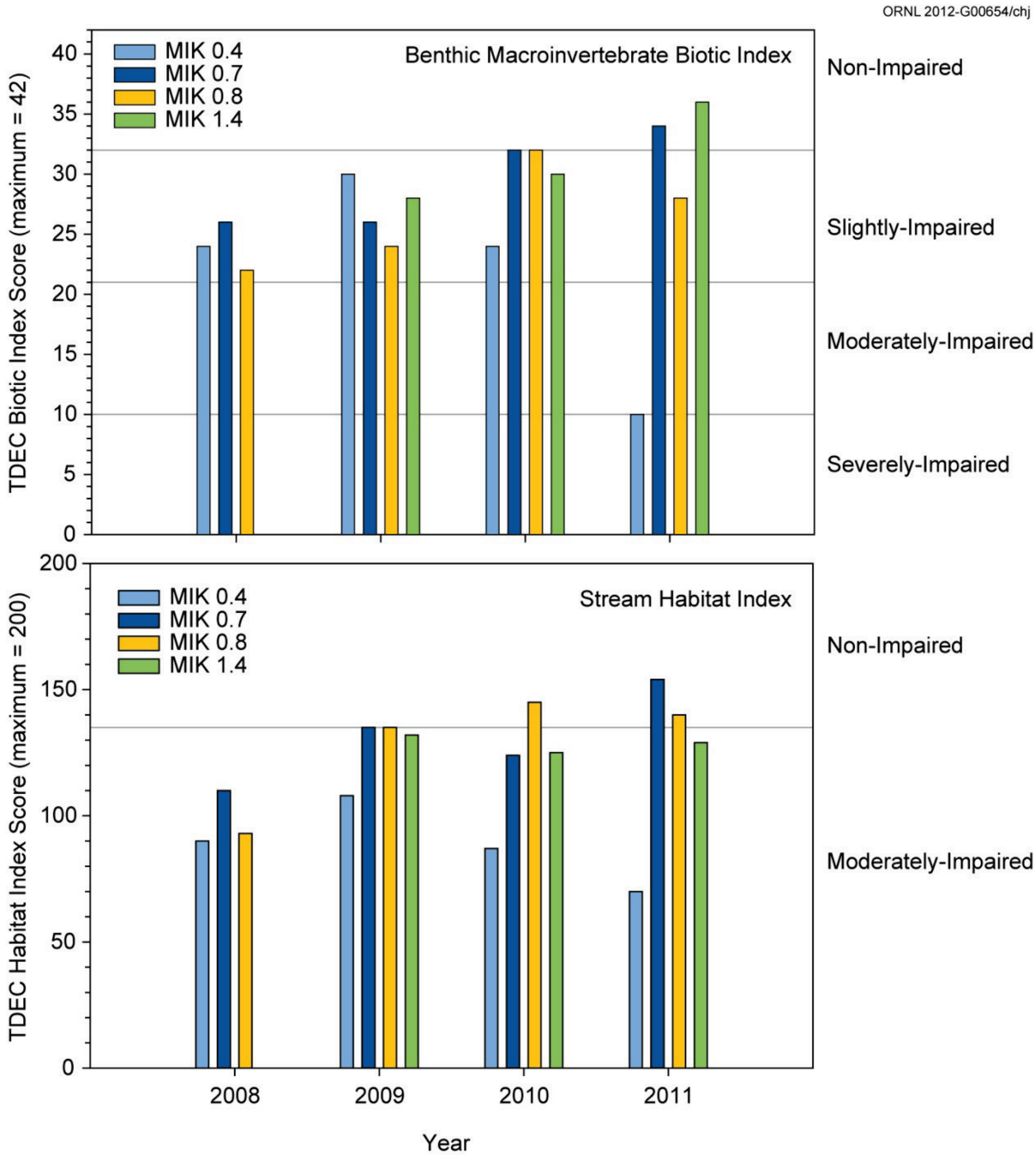

Fig. 3.69. Temporal trends in Tennessee Department of Environment and Conservation Biotic Index and Stream Habitat Index scores for Mitchell Branch, August 2008–2011. Horizontal lines in both graphs show the lower thresholds for narrative index ratings; respective narrative ratings for each threshold are shown on the right side of each graph.

Table 3.26. Fish species richness, density (individuals/m^2), and biomass (g fish/m^2) at Mitchell Branch sites (MIK) and reference sites, Mill Branch (MBK), Scarboro Creek (SCK), and Ish Creek (ISK) for March and April 2011

Species	MIK 0.7	MIK 0.4	MBK 1.6	SCK 2.2	ISK 1.0
Large-scale stoneroller *Campostoma oligolepis*	5.42 (15.50)	0.73 (1.87)	<0.01 (0.05)	0.17 (0.86)	0.41 (1.46)
Striped shiner *Luxilus chrysocephalus*	3.72 (7.36)	2.65 (2.95)	0.03 (0.33)	-	0.74 (3.02)
Tennessee dace *Chrosomus tennesseensis*	-	-	0.01 (<0.01)	-	0.03 (0.02)
Western blacknose dace *Rhinichthys obtusus*	1.59 (3.68)	0.24 (0.38)	0.14 (0.40)	0.22 (0.86)	0.17 (0.38)
Creek chub *Semotilus atromaculatus*	0.20 (0.92)	0.07 (0.20)	0.09 (0.68)	-	0.26 (1.63)
White sucker *Catostomus commersoni*	-	-	0.01 (0.31)	-	0.01 (0.12)
Western mosquitofish *Gambusia affinis*	0.03 (0.02)	0.15 (0.05)	-	-	-
Banded sculpin *Cottus carolinae*	0.06 (0.32)	0.07 (0.45)	-	0.36 (1.46)	0.16 (1.18)
Redbreast sunfish *Lepomis auritus*	0.05 (0.08)	0.38 (0.65)	-	-	0.05 (0.10)
Hybrid sunfish *Lepomis sp. x*	-	-	-	0.03 (0.32)	-
Green sunfish *Lepomis cyanellus*	0.38 (2.35)	0.30 (2.74)	-	0.12 (0.86)	0.70 (3.99)
Warmouth *Lepomis gulosus*	-	-	0.03 (0.16)	-	-
Bluegill *Lepomis macrochirus*	-	0.01 (0.20)	0.25 (0.57)	0.01 (<0.01)	-
Largemouth bass *Micropterus salmoides*	-	-	<0.01 (0.01)	-	-
Stripetail darter *Etheostoma kennicotti*	-	-	0.04 (0.07)	-	-
Snubnose darter *Etheostoma simoterum*	-	-	-	-	0.27 (0.46)
Logperch *Percina caprodes*	-	-		0.02 (0.93)	-
Species richness	8	9	10	6	10
Total density	11.45	4.60	0.60	0.93	2.80
Total biomass	30.23	9.49	2.58	4.63	12.36

3.7 Quality Assurance Program

UCOR is committed to developing, implementing, and maintaining a formal QA program that ensures the highest standards of performance by empowering employees in their respective areas of responsibility through fostering a "no fault" attitude toward the identification and reporting of quality deficiencies. The quality program provides the framework for a results-oriented management system that focuses on performing work safely and meeting mission and customer expectations while allowing UCOR and its subcontractors to become more efficient through process improvement.

The UCOR QA program is a management system that addresses three major elements: managing work, performing work (whether self-performed or subcontracted), and assessing the adequacy of work. The management element encompasses management programs, including organizational structure and responsibilities, and management processes, including planning, scheduling, and resource considerations. The management element also includes personnel training and qualifications, continuous improvement, and documents and records. The performance element includes work processes, design, procurement, and inspection and acceptance testing. The assessment element includes external assessments, independent assessments, and management assessments.

The UCOR QA program provides the primary requirements for the integration of quality functions into all aspects of UCOR activities. UCOR-4141, *URS | CH2M Oak Ridge LLC Quality Assurance Program Plan,* meets the requirements of ASME NQA-1, *Quality Assurance Requirements for Nuclear Facilities,* and 10 CFR 830, Subpart A, *Quality Assurance Requirements*, and includes the 10 criteria delineated in 10 CFR 830.122, *Quality Assurance Criteria*.

Where equivalent elements do not already exist, additional requirements for radioactive waste packaging are included from 10 CFR 71, Subpart H. DOE reviews and concurs with changes made to the program annually.

The QA program requirements are reflected in implementing procedures. Subcontractors must meet the same requirements delineated in the UCOR QA program when developing and following their own QA plans for each scope of work or when following the UCOR QA program in executing work scope. Through its UCOR Park Worker Biannual Training Program, UCOR introduces and emphasizes the importance of the QA program so that it is understood by UCOR and subcontract personnel.

New and revised DOE standards (e.g., orders, manuals, technical standards, guides) are screened by UCOR QA organization staff for applicability to UCOR work scope and to recommend an approach for developing UCOR's position on incorporation into the contract. Applicable standards are routed to functional managers and subject matter experts (SMEs). Necessary actions to address new and/or revised federal, state, and local laws and regulations are considered by the UCOR Standards Review Board, whose responsibilities include evaluating issues to determine the need for considering changes to UCOR contractual standards as a result of the following:

- challenges that relate to the appropriateness of safety standards;
- changes to federal, state, and local laws and regulations;
- changes to voluntary consensus standards included as contractual standards;
- changes to approved DOE directives that address safety requirements; and
- new work scope or hazards.

Links to the current set of contractual standards and requirements are maintained on the UCOR website. Additional links are provided for reference to DOE's directives. The UCOR organizational structure, functional responsibilities, levels of authority, and interfaces for those planning, managing, performing, and assessing the work are defined in company policies, program plans, program procedures, directives, and subcontracts, as appropriate.

The UCOR QA organization has a key role in implementing continuous improvement and provides direct support to program and project teams throughout the company to facilitate integration of QA requirements into project activities. The UCOR QA functional manager is responsible for providing central leadership, direction, and assessment of the UCOR QA program and for assisting UCOR project managers and subcontract coordinators in verifying that, when required, subcontractors have an adequate QA plan in place before work is initiated.

UCOR senior management is responsible for the leadership and commitment to quality achievement and improvement within a framework of public, worker, and environmental safety. UCOR management also has the primary responsibility and accountability for the scope and implementation of the UCOR QA program. UCOR personnel are held directly responsible for the quality of their work; line management has final responsibility for the achievement of quality. UCOR personnel have the responsibility to immediately stop work if an operation or process seriously jeopardizes safety, health, or the environment or if it possesses imminent life-threatening implications as defined in UCOR procedures. These responsibilities are passed down to subcontractors through language contained in each subcontract and through the *Worker Safety and Health Program* (UCOR 2012c) and *Environmental Compliance and Protection Program* (UCOR 2012d).

The UCOR QA program is implemented through management processes that include training personnel and verifying their qualifications; identifying opportunities for improvement; controlling documents and records; and planning, scheduling, and identifying resources.

The quality of items, services, and processes is ensured for subcontracts through the procurement process by requiring subcontractors to work under the UCOR QA program or to provide a QA plan that identifies the specific quality requirements applicable to the subcontractor's scope of work.

Environmental management operations include environmental cleanup, waste management, and reindustrialization activities. The ultimate success of UCOR's environmental program and projects depends on the quality of the environmental data collected and used in the decision-making process. Environmental data operations include the collection, management, use, assessment, retention, and reporting of such data. Additional QCs applied to environmental sampling activities are addressed in UCOR 4189, *Quality Assurance Project Plan for Environmental Data Operations,* and UCOR 4949, *Quality Assurance Project Plan for the Water Resources Restoration Program*.

All activities involving the generation, acquisition, and use of environmental data are planned and documented. The type and quality of the data are determined with respect to their intended use. The data quality objective process establishes the objectives for data collection and quality. Determining the type and quality of environmental data needed involves data users and personnel responsible for activities affecting data quality.

Data quality objectives and other QA protocols are incorporated in environmental monitoring programs at ETTP through SAPs and the associated laboratory statements of work. The monitoring program SME and the UCOR Sample Management Office (SMO) collaborate in choosing the most appropriate analytic methods for both radiological and nonradiological monitoring. Sample quantitation levels (the point at which it is possible to quantify the concentration within the appropriate level of confidence), screening levels for notification, analytical methods, and other information necessary to ensure the data collected are of the appropriate quality are included in the plans. SMO and the monitoring program SME review these criteria with contracting laboratories to ensure they are capable of meeting the criteria. If for any reason a laboratory is unable to meet any of the requested criteria, the monitoring program SME must determine whether the laboratory's capabilities are adequate. The appropriate action is then taken to either amend the statement of work (SOW) or send the analytical work to a laboratory capable of meeting the monitoring program needs.

Laboratories conducting radiological and nonradiological analyses for ETTP environmental monitoring programs are reviewed periodically by SMO to ensure the quality of their analytical work continues to meet the appropriate standards. In 2011, all laboratories used in ETTP environmental monitoring programs performed satisfactorily. Laboratories used by ETTP must be approved by DOE's Analytical Services Program (i.e., the DOE Consolidated Audit Program audit team), which conducts routine audits (at least once a year, and more frequently if a problem is noted) to ensure that the analyses are of the highest quality.

When data are received from a laboratory, SMO reviews the data package from the laboratory. Data completeness, quantitation levels, screening levels, holding times, and methods are examined to ensure all quality aspects of the analyses meet the criteria set forth in the SAP and the SOW. Any deficiencies are noted, and the laboratory is contacted for clarification, if necessary. When SMO is satisfied that the data are complete and meet all criteria, the data are forwarded to the monitoring program SME. The monitoring program SME conducts further reviews and uses the data in the appropriate calculations and reports.

Selected programs or projects impose unique QA requirements on their activities. Such special QA program requirements (quality assurance project plans) are added to and where possible integrated with the basic UCOR QA program requirements for the affected facilities and activities. For subcontracted work, the necessary QA requirements are included in subcontract language or the subcontractor is required to develop a QA plan to be submitted to UCOR for review and approval. These special QA requirements are applicable to a specific work scope and are monitored by UCOR and/or subcontractor personnel as appropriate.

3.7.1 Integrated Assessment and Oversight Program

QA program implementation and procedural and subcontract compliance are verified through the UCOR Integrated Assessment and Oversight Program. The program identifies the processes for planning, conducting, and coordinating assessment and oversight of UCOR activities, including both self-performed and subcontracted activities, resulting in an integrated assessment and oversight process. The program is composed of three key elements: (1) external assessments conducted by organizations external to UCOR, (2) independent assessments conducted by teams independently of the project/function being assessed, and (3) management assessments and surveillances conducted as self-assessments and surveillances by the organization or on behalf of the organization manager.

Self-assessments are performed by the organization/function with primary responsibility for the work, process, or system being assessed. Organizations and functions within the company plan and schedule self-assessments. Self-assessments encompass both formal and informal assessments. The formal self-assessments include management assessments and surveillances and subcontractor oversight. Informal self-assessments include weekly inspections and routine walkthroughs conducted by subcontractor coordinators, ES&H representatives, quality engineers, and line managers.

Conditions adverse to quality identified from internal and external assessments are documented, causal analyses are performed, and corrective actions are developed and tracked to closure. Analyses are conducted periodically to identify trends for management action. Senior management evaluates data from those processes to identify opportunities for improvement.

3.8 Environmental Management and Waste Management Activities

3.8.1 Waste Management Activities

Restoration of the environment, D&D of facilities, and management of the legacy wastes constitute the major operations at ETTP.

The TSCA Incinerator located at ETTP was shut down permanently on December 2, 2009, after treating 35.6 million lb of liquid and solid waste over a 19-year period. The TSCA Incinerator was a one-of-a-kind thermal treatment unit. It played a key role in treating radioactive PCBs and hazardous wastes (mixed wastes) from ORR and other facilities across the DOE complex, thus facilitating compliance with regulatory and site closure milestones. The certified closure report was submitted to TDEC and EPA in June 2011. Efforts to encapsulate remaining PCB and radioactive contamination continued through 2011. Upon completion of these activities, the facility will be under surveillance and maintenance until demolition.

EMWMF, located in Bear Creek Valley west of the Y-12 Complex, is an engineered landfill that accepts waste generated from cleanup activities on ORR. It currently consists of six disposal cells. The sixth and final cell was completed in spring 2011 and brought the total disposal capacity to 2,180,000 yd^3. In addition, two 30,000 gal leachate storage tanks and four 250,000 gal contact water storage tanks were added to improve the facility's water management capability. EMWMF accepts low-level radioactive and hazardous wastes that meet specific waste acceptance criteria developed in accordance with agreements with state and federal regulators. Waste types that qualify for disposal include soil, dried sludge and sediment, solidified wastes, stabilized waste, building debris, scrap equipment, and personal protective equipment. During FY 2011, EMWMF operations collected, analyzed, and dispositioned about 6.2 million gal of leachate and 1.2 million gal of contact water at the ORNL Liquid/Gaseous Waste Operations Facility. An additional 13.7 million gal of contact water was collected, analyzed, and released to the storm water retention basin after it was determined that it met the release criteria. EMWMF received about 19,507 truckloads of waste accounting for about 197,000 tons during FY 2011. Projects that have disposed of waste at EMWMF during the year include the following:

- K-25 Building Demolition Project, including waste generated from the west wing demolition;
- K-33-Building Demolition Project;
- ETTP Decontamination and Decommissioning Project, including K-770 scrapyard, K-1070-B burial ground, and K-1093 scrapyard debris;
- Y-12 Old Salvage Yard Project, Alpha 5 Project, and Biology Project; and
- several ORNL demolition projects.

CNF, located at ETTP, treated 7.3 million gal of wastewater in FY 2011. The facility is ETTP's primary wastewater treatment facility and processes both hazardous and nonhazardous waste streams arising from multiple waste treatment facilities and remediation projects. The facility removes heavy metals and suspended solids from the wastewater, adjusts pH, and discharges the treated effluent into the Clinch River. Sludge from the treatment facility is treated, packaged, and disposed of off-site. The main waste stream is the hexavalent-chromium-contaminated groundwater collected from the chromium collection system near Mitchell Branch. The facility also continued to treat wastewaters generated at the TSCA Incinerator, including remediation and investigation projects to support the TSCA Incinerator closure activities. CNF is scheduled to be shut down in FY 2012 for decommissioning after a smaller chromated water treatment unit that will sit within the existing CNF footprint has been established.

At ORNL, about 117 million gal of wastewater were treated and released at the Process Waste Treatment Complex. In addition, the liquid low-level waste evaporator at ORNL treated 163,610 gal of such waste. A total of 2.2 billion m^3 of gaseous waste was treated at the ORNL 3039 Stack Facility.

These waste treatment activities supported both EM and Office of Science mission activities in a safe and compliant manner during FY 2011. NNSA at the Y-12 Complex treated 127 million gal of contaminated ground/sump water at the Groundwater Treatment Facility, Central Mercury Treatment System, Big Springs Water Treatment System, and East End Volatile Organic Compounds Treatment System.

The Big Springs Water Treatment System treated 112 million gal of mercury-contaminated groundwater. The East End Volatile Organic Compound Treatment System treated 11 million gal of VOC-contaminated groundwater. The West End Treatment Facility and the Central Pollution Control Facility at the Y-12 Complex processed 1.2 million gal of wastewater primarily in support of NNSA operational activities. The Central Pollution Control Facility also down-blended more than 37,175 gal of enriched wastewaters using legacy and newly generated uranium oxides from on-site storage. EMWMF began operations in 2002 to provide on-site waste disposal capacity from remediation efforts across ORR. Although it has been expanded to its maximum capacity, EMWMF will not be able to handle all of the waste expected to be generated from reservation cleanup activities.

Further expansion at EMWMF is constrained by physical limitations of the site. Therefore, DOE began evaluating disposal alternatives in FY 2010 for future reservation waste cleanup. Similar to the CERCLA process that was completed for the existing EMWMF, DOE will evaluate the following alternatives detailed in a focused feasibility study:

- no action,
- on-site disposal (constructing and operating a new disposal facility on the reservation), and
- off-site disposal (shipping to an off-site facility).

The on-site disposal alternative includes consideration of options for siting a new facility in the East Bear Creek Valley area or in two other candidate areas (White Wing Scrap Yard and West Bear Creek Valley).

The use of RFIDs was implemented for waste shipments to EMWMF. This innovation allows for faster and more accurate tracking of waste shipments and reduces paperwork, decreases the shipment cycle time, and improves security of the materials being transported along the haul road.

The ORR landfills are located near the Y-12 Complex and are designed for the disposal of sanitary, industrial, construction, and demolition wastes that meet the waste acceptance criteria for each landfill. In FY 2010, more than 139,000 yd^3 of waste was disposed of at these facilities, and more than 1.4 million gal of leachate was collected, monitored, and discharged to the Oak Ridge sewer system. In 2011, construction of Landfill V Area IV was completed and truck receiving and inspection facilities and leachate management infrastructure were upgraded.

3.8.2 Environmental Restoration Activities

ETTP operated as an enrichment facility for four decades during which time many of the buildings became contaminated to some degree with radionuclides, heavy metals, and toxic organic compounds. In addition, large quantities of wastes were generated, much of which was stored on the site.

ETTP's Environmental Management Program was created with the goal of demolishing all unnecessary facilities and restoring the site to a usable condition. The safety and health of employees and the public is a constant focus. Cost-effectiveness is also a major consideration in the cleanup operations.

DOE has signed two of three key CERCLA RODs with the State of Tennessee and EPA authorizing environmental restoration of about 890 ha of land at ETTP. The area encompasses about about 567 ha outside the main plant security fence (Zone 1) and about 324 ha inside the fence within the former plant production area (Zone 2). The main objectives of the two decisions are to protect future industrial workers and the underlying groundwater from contamination in soil, slabs, and subsurface structures. The Zone 1 interim ROD was signed in November 2002 and covers the 567 ha area surrounding ETTP outside the main plant perimeter. The Zone 2 ROD was signed in April 2005 and covers the approximately 324 ha in the main plant area. The final sitewide ROD for groundwater, surface water, sediment, and ecological soil risk is in development.

From the time cleanup operations began through FY 2011, 246 facilities have been demolished, 1.6 million yd^3 of waste have been removed from the site, and 1,400 acres of land have been cleared for unrestricted use. In addition, about 7,000 old UF_6 cylinders were removed from the site.

3.8.2.1 K-25 Building Demolition

The K-25 Building (Fig. 3.70), built during the Manhattan Project, occupied about 40 acres and contained more than 3,000 stages of gaseous diffusion and associated auxiliary equipment. Each stage consisted of a converter, two compressors, two compressor motors, and associated piping. In FY 2011, demolition of the East Wing began. Workers completely cut through a portion of the East Wing to segregate a portion of the building contaminated with technetium-99 (^{99}Tc) from the rest of the demolition area. The area contaminated with ^{99}Tc will be addressed separately from the rest of the demolition project. Debris from the demolition project is being sent to EMWMF for disposal.

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Fig. 3.70. The K-25 Building after demolition of the west wing.

3.8.2.2 K-33 Building Demolition

Building K-33 was a multistory building that was built in 1954 as a uranium enrichment process building. The building covered 32 acres and contained more than 1.4 million yd^3 of concrete and steel The building had been largely decontaminated under an earlier project. In FY 2011, the building was completely demolished and the debris removed to EMWMF. The demolition was finished 5 months ahead of schedule, and the debris removal was completed 3 months ahead of schedule. In FY 2012 the building slab and associated contaminated areas are scheduled to be excavated and removed.

3.8.2.3 Groundwater Treatability Study

Remediation activities to reduce ETTP groundwater and surface water contamination continued in FY 2011. Work was initiated in FY 2010 to prepare a Zone 1 final ROD that will address groundwater and ecological protection. Fieldwork on that project will be initiated in FY 2011.

A two-phase groundwater treatability study at ETTP began in FY 2009 to support selection of a sitewide groundwater remedy. The purpose of the study was to determine the feasibility of in situ treatment technologies to restore the groundwater. Two in situ technologies have been identified as possibilities, and one or both may be suitable: thermal conductive heating and biological treatment. The purpose of the first phase of the study was to characterize and delineate suspected areas of solvent contamination. Seven boreholes were installed to depths of 110 to 160 ft below ground surface in FY 2009 (Fig. 3.71).

In FY 2010, DNAPL was detected in one of the boreholes in the vicinity of the former K-1401 Vapor Degreasing Tank. DNAPLs are

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Fig. 3.71. Drilling exploratory boreholes near the K-1401 area.

a group of organic substances that are relatively insoluble in water and denser than water. Seven additional boreholes were installed to further delineate the lateral extent of DNAPL contamination.

A workshop was held in September 2010 to review the data and select a technology for a phase II pilot field study. The workshop concluded that in situ thermal treatment may be appropriate for DNAPL treatment in the weathered bedrock zone, that in situ thermal or biological treatment may be appropriate for treatment of the unconsolidated zone, and that a waiver may be appropriate for the deep bedrock zone. The objective of the study is to determine whether these technologies would be effective in reducing the mass of contamination in the groundwater and reducing the risk of exposure to human health and the environment. Due to a number of factors, no fieldwork occurred on this project in 2011.

3.8.2.4 Soil, Burial Ground, and Exposure Unit Remediation Activities

The soil at ETTP is to be remediated to a level that protects a future industrial workforce and the underlying groundwater. RODs detailing the selected cleanup methods are in place and address soil, slabs, subsurface structures, and burial grounds for both zones.

Remediation of the soils in Zone 1 was completed in 2011. The final efforts included completion of the K-770 scrapyard cleanup, cleanup of hot spots near the duct banks, and grouting of the duct bank manholes (DOE 2007).

In Zone 2, work in exposure units (EUs) 31 and 32 was completed, and remediation of the K-1070-B burial ground continued. EU 31 is in the center of ETTP and spans about 8.5 ha. A phased construction completion report (PCCR) was completed that documented the characterization of the EU, the remediation of the K-1035 slab and underlying soil, the removal of the K-1401 slab, and the backfilling of the K-1401 basement.

EU 32 also is in the center of ETTP and spans about 7.4 ha. A PCCR was prepared that documented the characterization of the EU and the remediation of the K-1066-G yard, which consisted of the removal of equipment and material that were stored there.

At the end of FY 2011, about 4,226 yd^3 were excavated from the K-1070-B burial ground and shipped to EMWMF for disposal. Some of the soil excavated from K-1070-B will require disposal at off-site disposal facilities such as NNSS. Excavation of the trenches was completed.

3.8.2.5 Mitchell Branch Chromium Collection System

In 2007, surveillance data indicated that the chromium levels in Mitchell Branch had markedly increased. Subsequent analyses showed that the chromium was almost entirely in the hexavalent state. Because hexavalent chromium has not been used at ETTP for many years, it is believed that the source is groundwater contaminated with legacy material and not a result of current operational issues. The chromium collection system consists of a grout layer to impede the flow of the groundwater and two extraction wells and pumps to pump the groundwater from the vicinity of storm water Outfall 170 for treatment at CNF and discharge through the CNF NPDES outfall. Since the installation of this system and subsequent modifications to increase pumping rates, chromium levels in Mitchell Branch have been reduced to well below the WQC of 11 µg/L and near or below the detection levels of 1 to 3 µg/L. In FY 2010, DOE approved a non-time-critical removal action for a long-term solution to the release of hexavalent chromium into Mitchell Branch. The removal action work plan and conceptual design were completed in FY 2010. In 2011, CWTS construction was completed, and testing of the system began. CWTS will provide long-term treatment of the collected chromium contaminated water.

3.8.2.6 K-1007 Ponds Remediation

Largemouth bass from the K-1007-P1 pond were known to accumulate high concentrations of PCBs in their muscle tissue. As a result of multiple studies of the pond, the major source of PCB contamination was thought to be the sediments, which are easily suspended by bottom-feeding fish like carp and shad, especially in this system where grass carp totally decimated pond plants that historically served to stabilize the sediments. High nutrient loads in the pond from a large goose population were thought to contribute high suspended algal biomass. Lipid-rich gizzard shad, which forage on sediment and suspended algae and therefore accumulate very high PCB levels, served as a major vector of PCB transfer to largemouth bass and wildlife. In 2009, a non-time-critical removal action was implemented that used fish, wildlife, and plant management principles to minimize the risks associated with PCBs in the pond. The problem fish were removed from the pond, geese were discouraged from the area, and extensive pond recontouring and planting were conducted. The goal was to create in the pond a population of relatively low bioaccumulator fish (i.e., primarily small sunfish), plus dense areas of rooted aquatic vegetation to stabilize the sediment to prevent resuspension. This innovative approach was deemed more cost-effective than traditional dredging operations and served to preserve the pond as an ecological and aesthetic asset for the area.

Fish removal, recontouring, and revegetation were completed at the ETTP P1 pond located next to Building K-1007 (Fig. 3.72). Fish removal was also conducted in two additional ETTP ponds located adjacent to Highway 58, with about 8.5 tons of fish recovered from all three. Removal of the fish was necessary because the species that were in the ponds would stir the contaminated sediment at the bottom of the ponds. The ponds were restocked with fish species that are less likely to disturb the pond sediment. Barriers were placed to prevent fish from migrating into the ponds from Poplar Creek. The fish barrier at the K-1007 B weir was damaged during FY 2010 after a severe weather event. Undesirable fish that reentered the ponds were removed, and the fish barrier was repaired. In 2011, dead and dying vegetation was replaced by fresh stock, and follow-up fish removals were conducted to ensure that unwanted species had not recolonized the ponds.

ORNL 2011-G00823/chj

Fig. 3.72. Revegetating the K-1007-P1 pond.

3.8.3 Reindustrialization

The Reindustrialization Program was developed to accelerate cleanup of the site and to allow for beneficial reuse of underused facilities and land. Facilities determined appropriate for reuse are leased or transferred to non-DOE entities such as CROET or the city of Oak Ridge. CROET is a not-for-profit corporation established to foster diversification of the regional economy by reusing excess DOE property for private sector investment and job creation.

With the property and infrastructure transfers and upgrades in CY 2011, the DOE Oak Ridge Office Reindustrialization Program continues as the model for sustainable innovative reuse of assets while progressing toward DOE's vision to transform ETTP into a private sector business/industrial park. In

CY 2011 the Reindustrialization Program transferred land parcels ED-9 and ED-10 and leased 282 acres in the former powerhouse area to CROET. ED-9 comprises about 13 additional acres, with supporting infrastructure. ED-10 comprises about 13 acres in the northeastern portion of ETTP. Additional land areas at ETTP are in various stages of the transfer process, and utility infrastructure improvements continue to support expansion of ETTP. In addition to land, DOE completed the Phase II Electrical Distribution System in April 2011. The Phase II portion of the electrical system removed the TVA direct 161 kV power feed to ETTP and connected ETTP to the City of Oak Ridge's power supply

In FY 2011, CROET sold one of the two speculative buildings and continued upgrading the fire protection systems in the privately owned buildings at ETTP, while the city constructed a new power line from its substation to serve the speculative buildings and land parcels ED-5 East and West.

DOE has now transferred ownership of about 193 acres of land (Fig. 3.73) and 332,000 ft^2 of building space at ETTP. These transfers have been made via a provision in CERCLA that allows for the transfer of property for economic development purposes. These activities are all part of DOE's plan to transform ETTP into a private sector business and industrial park.

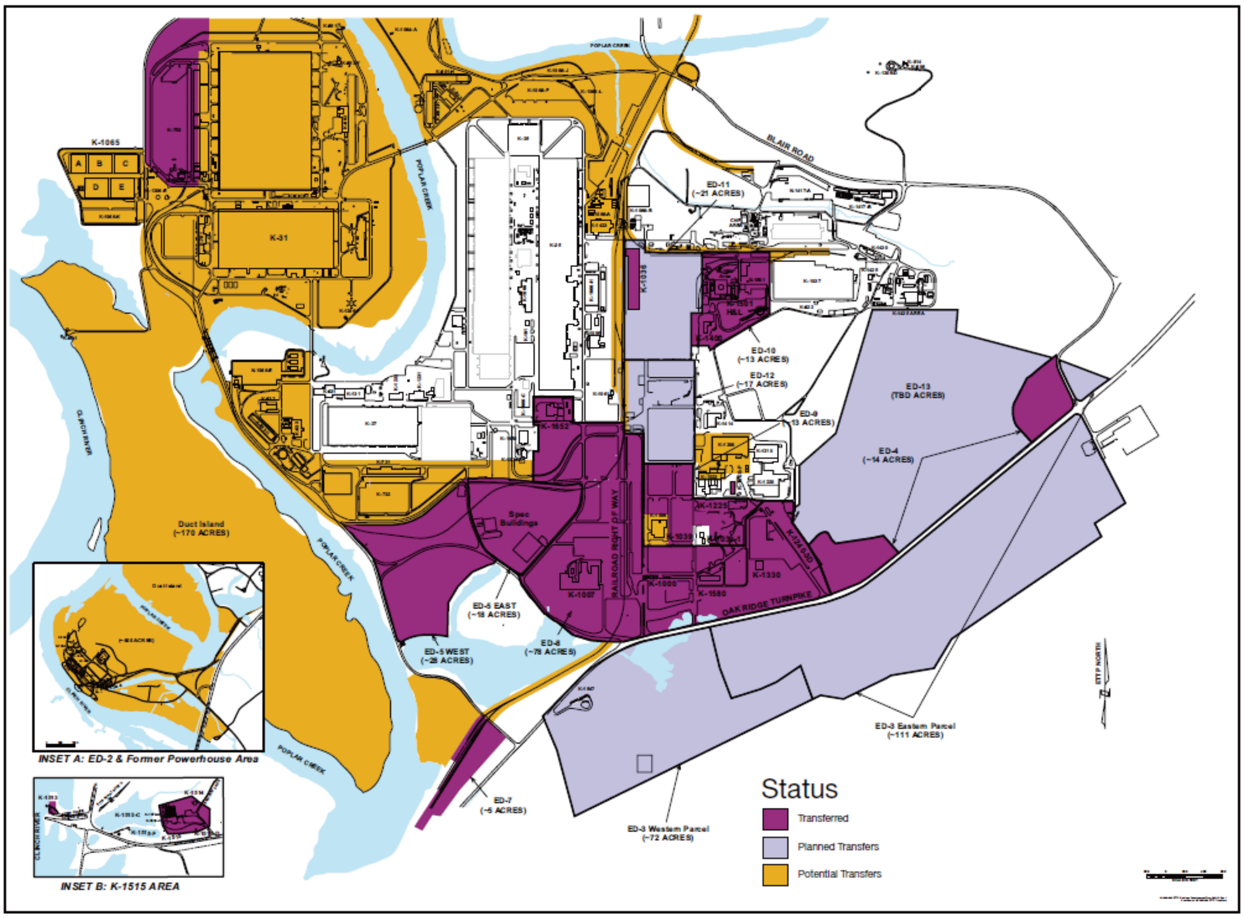

Fig. 3.73. East Tennessee Technology Park reindustrialization status, CY 2011.

3.8.4 Biosolids Program

Under the Biosolids Program, treated municipal sludge (biosolids) from the City of Oak Ridge (the city) publicly owned treatment works (POTW) is applied to six approved sites (Fig 3.74) on ORR as a soil conditioner and fertilizer. UCOR provides oversight for the program (BJC 2006), which operates under a land license agreement between DOE and the city. The city has applied biosolids on ORR since 1983.

Land application is included in the EPA policy on municipal biosolids, which was formally articulated in June 1984 (49 CFR 24358) as an example of beneficial use. Municipal biosolids are regulated by EPA under the provisions of Title 40 CFR Part 503 (CWA). These regulations establish standards for biosolids use and disposal, including risk-based, metal-loading criteria and agronomic (nitrogen) loading limits for the receiving soil. Additional requirements are imposed by the environmental assessments written for the program (DOE 1996, DOE 2003, and DOE 2012) and by TDEC through the land application approval process.

In addition to metals, POTW biosolids typically contain both natural and anthropogenic radionuclides. In particular, the Oak Ridge POTW biosolids contain trace quantities (parts per million) of slightly enriched uranium from the Y-12 Complex. Radionuclides in biosolids are not currently regulated by EPA. With the consent of TDEC, the city, and DOE, the Biosolids Program has established radionuclide guidance limits for the biosolids and receiving soil using radiation dose limit calculations. Currently the biosolids and soil limits are calculated using the residual radioactivity (RESRAD) model, assuming conservative pathway scenarios (DOE 1996, DOE 2003, and DOE 2012). Compliance is determined using the sum of the fractions approach for all monitored radionuclides.

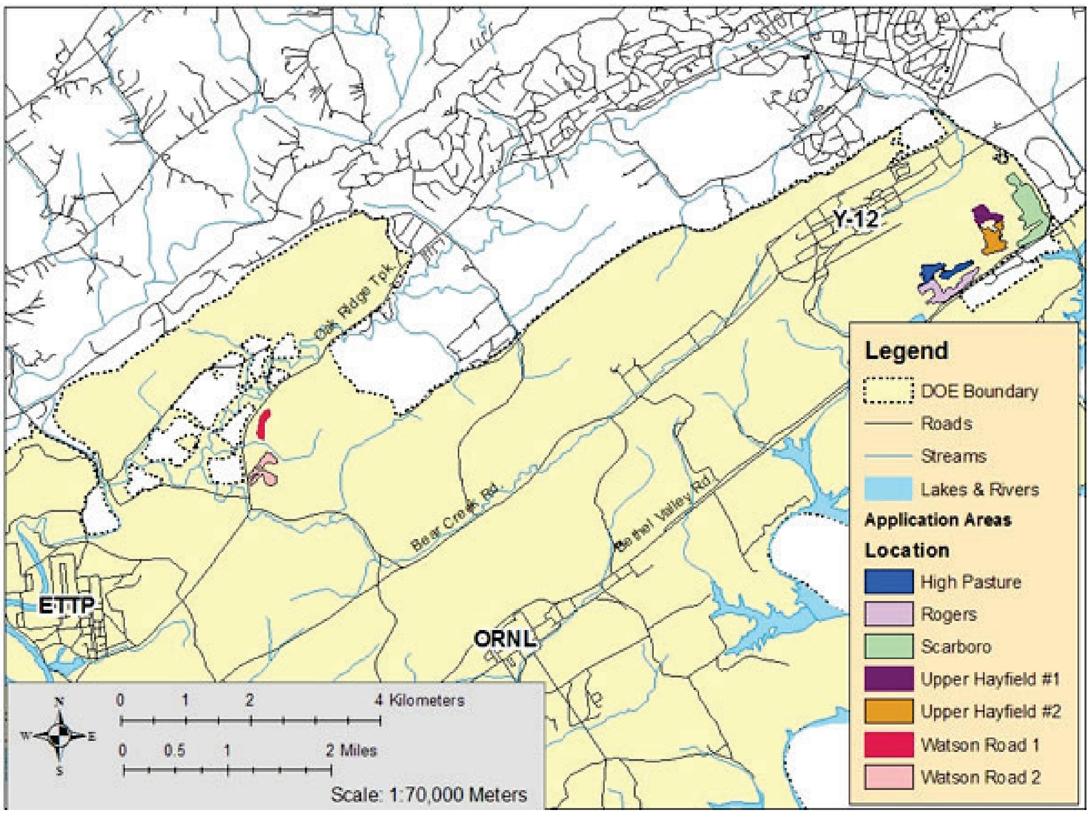

Fig. 3.74. Location of the biosolids application sites with respect to the East Tennessee Technology Park, Y-12 National Security Complex, and Oak Ridge National Laboratory facilities within the region.

The US Nuclear Regulatory Commission (NRC) regulations prohibit an unlicensed entity from receiving, possessing, or handling special nuclear material (SNM). The State of Tennessee, however, is authorized by NRC to exempt certain classes or quantities of SNM from the requirements of a potential license when it makes a finding that the exemption of such quantities of SNM would not constitute an unreasonable risk to the health and safety of the public. On April 29, 1993, the city requested a waiver from the SNM licensing requirement from the TDEC Division of Radiological Health (DRH). This waiver was granted by DRH on September 27, 1993. Accordingly, the SNM aspects of the Biosolids Program are in compliance with NRC and TDEC requirements.

3.8.4.1 Biosolids Fields at the Oak Ridge Reservation

The biosolids land application sites are located on ORR in Oak Ridge, Tennessee (Fig 3.74). Five of the active sites are in the vicinity of Bethel Valley Road, while the remaining active site, Watson Road, is located on Highway 95, near the Horizon Center. Table 3.27 presents the six application sites and their gross area in acres and hectares.

Table 3.27. Gross area of Oak Ridge Reservation active biosolids land application sites

Site	Acres	Hectares
Upper Hayfield #1	30	12.15
Upper Hayfield #2	27	10.93
High Pasture	46	18.62
Watson Road	117	47.37
Scarboro	77	31.17
Rogers	32	12.96

3.8.4.2 Current Program

The city POTW near Turtle Park in Oak Ridge, Tennessee, processes about 30 million gal/day of wastewater. The plant receives wastewater from a variety of industrial, commercial, and residential generators in the Anderson-Roane County area. DOE contributes about 20% of the influent to the POTW directly from the Y-12 Complex, with lesser amounts from ETTP through the Rarity Ridge treatment plant and from ORNL through tanker delivery of sludge. All industrial generators are required by Oak Ridge City ordinance number 5-09 to obtain an industrial discharge permit from the city, which prescribes discharge limits and monitoring/reporting requirements.

In 2001, the city began converting its anaerobic digestion process to an aerobic one, with the goal of developing a standard activated-sludge process in which biosolids from both the primary and secondary sedimentation basins are fed into aerobic holding tanks. From there, the liquid biosolids could be thickened and pumped to a belt press system for drying. By the middle of 2010, all of the tanks formerly used for anaerobic treatment had been converted to aerobic digesters.

Production of Class B biosolids with 20% to 25% solids content is the intended result of the aerobic process. The Class B product will be transported to one of the six active application sites using a standard-size discharge manure spreader. It is estimated that up to 2,600 lb of dry solids could be applied to the land on an average day.

3.8.4.3 Current Status

The public review phase for the draft environmental assessment (DOE 2012) began in August of 2011, with completion and approval in January 2012. This environmental assessment documents application setbacks and radiological guidance levels that have been revised to reflect the latest field surveys and analytical data for biosolids.

In 2010, the city had accumulated about 750,000 gal of Class A equivalent low solids content (about 97%–98% liquid) biosolids in digesters as a result of attempts to produce the desired Class B product. Under a land application approval from TDEC, the city began application of the low solids content biosolids in November 2010 at ORR using a sprayer truck. Application setbacks established in the environmental assessment (DOE 2003) were observed. These restrictions included protective setbacks for surface water features and areas with potential channels to groundwater of, respectively, 500 ft, and 50 ft around waters of the state. In accordance with industry best-management practices, application was not conducted under conditions of saturated site soil, precipitation, or excessive wind. Additionally, in accordance with TDEC land application guidance, application was not conducted on slopes greater than 8%. In 2011, 13.3 dry tons of biosolids were land-applied on area LA01.TN-AN-1, located within the High Pasture site.

Application continued in 2011 with the goal of emptying the digesters in order to restart development of the Class B lower solids content product. The information in Table 3.28 documents the removal of all remaining pumpable material from the digesters. Application setbacks established in the environmental assessment DOE/EA-1356 were observed. From February 2011 through October, 2011, the city applied 20.16 dry tons of liquid biosolids on TDEC-approved areas within the High Pasture and Rogers application sites.

Any unpumpable material may be allowed to remain in the digesters when the product development resumes in March 2012.

Table 3.28. Biosolids applied during 2011
Area LA01.TN-AN-1 (High Pasture)
Maximum Loading: 16.5 tons

Date	lb (dry)	tons (dry)	tons (cumulative)	% of max
2/16/2011	656	0.328	3.936	23.9
2/17/2011	1617	0.808	4.744	28.8
3/21/2011	1284	0.642	5.386	32.6
3/22/2011	1885	0.942	6.329	38.4
4/4/2011	972	0.486	6.815	41.3
4/7/2011	1266	0.633	7.448	45.1
4/8/2011	917	0.458	7.906	47.9
4/19/2011	1202	0.601	8.507	51.6
5/2/2011	844	0.422	8.929	54.1
5/3/2011	417	0.208	9.138	55.4
5/9/2011	853	0.426	9.564	58.0
5/10/2011	1225	0.612	10.177	61.7
5/11/2011	798	0.399	10.576	64.1
5/12/2011	1679	0.839	11.415	69.2
5/13/2011	743	0.371	11.787	71.4
5/31/2011	468	0.234	12.021	72.8
6/1/2011	477	0.238	12.259	74.3
6/2/2011	661	0.330	12.59	76.3
6/3/2011	1486	0.743	13.333	80.8

Area LA01.TN-AN-4 (Rogers)
Maximum Loading: 14.89 tons

Date	lb (dry)	tons (dry)	tons (cumulative)	% of max
7/1/2011	1418	0.709	0.709	4.8
7/7/2011	725	0.362	1.071	7.2
8/23/2011	1321	0.6605	1.732	11.6
8/24/2011	468	0.234	1.966	13.2
9/1/2011	408	0.204	2.17	14.6

Area LA01.TN-AN-5 (Rogers)
Maximum Loading: 17.33 tons

Date	lb (dry)	tons (dry)	tons (cumulative)	% of max
6/30/2011	2587	1.293	1.293	7.5
7/1/2011	1417	0.708	2.002	11.6
7/14/2011	807	0.403	2.405	13.9
7/19/2011	798	0.399	2.804	16.2
7/20/2011	844	0.422	3.226	18.6
8/15/2011	1009	0.504	3.731	21.5

Table 3.28. (continued)

Date	lb (dry)	tons (dry)	tons (cumulative)	% of max
8/16/2011	1514	0.757	4.488	25.9
8/17/2011	1514	0.757	5.245	30.3
8/18/2011	862	0.431	5.676	32.8
8/22/2011	1009	0.504	6.180	35.7
8/25/2011	1349	0.674	6.855	39.6
8/29/2011	872	0.436	7.291	42.1
8/30/2011	1170	0.585	7.876	45.4
9/2/2011	142	0.071	7.947	45.9
10/6/2011	376	0.188	8.135	46.9
10/10/2011	225	0.112	8.247	47.6
10/25/2011	332	0.166	8.413	48.5
10/26/2011	367	0.183	8.597	49.6

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